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## STUDIES OF THE ROENTGEN ERYTHEMA OF THE HUMAN SKIN<sup>1</sup>

### II. SKIN CAPILLARY CHANGES AFTER EXPOSURE TO FILTERED ROENTGEN RAYS AND TO ULTRA-VIOLET RADIATION

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SINCE the publication of the first paper<sup>2</sup> in this series, we have extended our observations to studying the behavior of the skin capillaries after exposure to filtered roentgen rays of short wave length and also to ultra-violet radiation. Considerable time was taken in developing a photographic method which permits the recording of the capillary appearance on a plate. Although we succeeded in producing good negatives, this procedure in its present form takes so much time in the preparation of a single record that we had to return to the drawing of the microscopic picture, as described in the previous article. We are striving, however, to perfect this photographic method because it is the ideal way to employ in this research. In the meantime Niekau (1) and Crawford and Rosenberger (2) have designed an apparatus for the cinematographic reproduction of the skin capillaries, a method which shows the continuously occurring changes in the pulsating blood vessels. The writer had the privilege of demonstrating before the Radiological Society of North America, in Milwaukee, the motion picture film "Human Skin Capillaries and Their Changes during

Circulation of the Blood," made by Professor Niekau, and wishes to take this opportunity of expressing his appreciation to the author for his courtesy. Crawford and Rosenberger studied the capillaries under normal conditions (3) and in cases of auricular fibrillation (4), and analyzed the observations made on the motion picture film.

We employed again the skin microscope (Mueller) and followed the technic described in detail in a recent paper (5). Only patients (numbering 87) who were to be submitted to therapeutic exposure were used in our investigations except in such investigations as dealt with ultra-violet rays. In this case, we felt quite at liberty to choose normal adults. It may be stated that all observations reported are based on the study of the effect of a full erythema dose given in a single exposure or in quarters on four successive days. Care was taken to select patients who were not suffering from diseases of the heart or blood vessels, nephritis, toxic goiter, diabetes, or neuroses. It is well known that in these conditions the capillaries are much more susceptible to stimuli.

#### 1. *Exposure to filtered roentgen rays.*

The radiation used is defined as follows: 200 K.V., 25 ma., 50 cm. F.S.D., 0.5 or 1.0

<sup>1</sup>Paper read by title before the Twelfth Annual Meeting of the Radiological Society of North America, at Milwaukee, Wisconsin, November 29 to December 4, 1926.

<sup>2</sup>See this Journal, March, 1926, VI, 236.

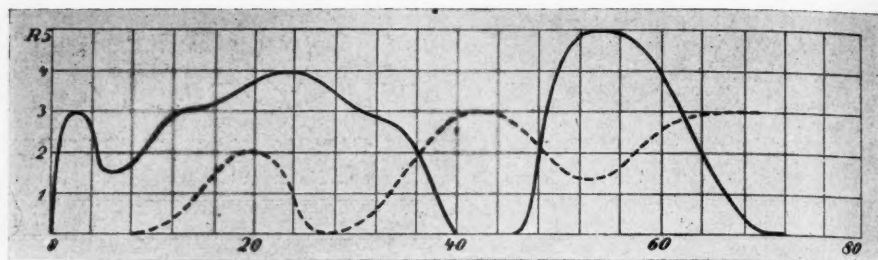


Fig. 1. The straight line represents the degree of erythema, the dotted line the pigmentation. (Taken from G. Miescher, *Strahlentherapie*, 1924, XVI, 345.)

Cu. plus 1.0 Al.,  $\lambda$  effective 0.16 and 0.14, respectively. The erythema dose for a field of  $20 \times 20$  cm. equals 14 and 22 minutes, or 1,500 and 1,700 R-units (measured on the patient), respectively. The parts of the body examined were arms, chest, abdomen, upper thigh, back, and neck. No important difference except slight variation in the degree of the reaction owing to the different sensibility of certain parts of the skin could be noted. When comparing the capillary changes with the macroscopic change in the skin, *i.e.*, erythema and following pigmentation, we were unable to differentiate so clearly as in our study of unfiltered radiation, the several cycles or periods of erythema according to Miescher (6). Most of our cases presented a form of reaction which Miescher calls the confluent type; in other words, all cycles blend and are not separated by a reaction-free interval. One of his curves showing this course of erythema and pigmentation is illustrated in Figure 1. It may be mentioned also that in our observations the second cycle very often represented the peak of the reaction. We will now describe the course of the microscopic and macroscopic reaction in the skin after exposure to one erythema dose of filtered radiation.<sup>3</sup>

Exposure of the flexor side of the left forearm to one erythema dose of filtered

roentgen rays ( $\lambda$  effective = 0.15) was given (Figure 2 shows the area before irradiation).

*After 6 hours:* No change.

*After 24 hours:* There was no macroscopic reaction at all; the capillaries were rather decreased in number (Fig. 3).

*After 48 hours:* A suggestion of reddening of the skin; a few capillaries of the deeper layer have appeared; there is no marked increase of the superficial vessels (Fig. 4).

*After 72 hours:* A definite reddening of the skin is noticeable; the "reserve capillaries" have appeared; the whole field looks somewhat blurred, due to the hyperemia (Fig. 5).

*After 96 hours:* Erythema fading, at the same time, the capillary reaction is decreasing (Fig. 6).

*After 120 hours:* No marked change as compared with the previous observation.

*After 6 days:* The exposed area shows a deep red color; the superficial capillaries are increased in number, dilated, and the loop between arterial and venous part is thickened; the sub-papillary layer has become visible (Fig. 7).

*After 7 days:* Stage of the typical erythema, both macroscopically and microscopically (Fig. 8).

*After 10 days:* Beginning decrease of the reaction (Fig. 9).

*After 3 weeks:* Following the marked

<sup>3</sup>The author is indebted to Miss E. S. Perry, Medical Illustrator, and Mr. H. F. Minkley, Medical Photographer, of University Hospital, for preparing the illustrations in this article.

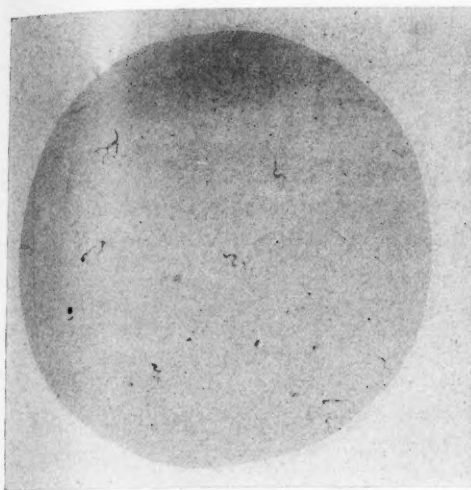


Fig. 2. The area before irradiation.

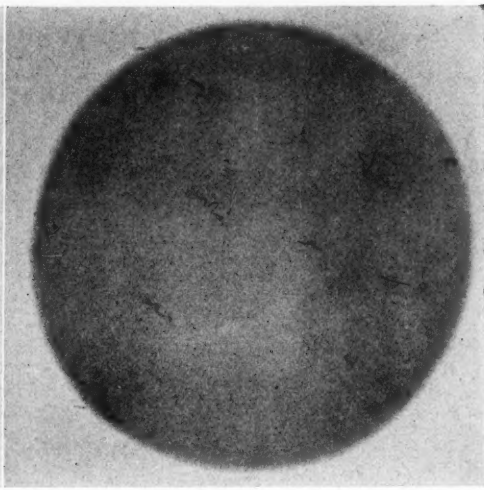


Fig. 3. Twenty-four hours after the exposure.

erythema, the background in the microscopic field changes to a yellowish tone, finally showing definite pigmentation; the capillaries remain dilated (Fig. 10).

*After 6 weeks:* A deep tanning of the whole area has taken place; the capillaries show a tendency to return to normal conditions (Fig. 11).

*After 2 months:* The pigment is fading; the capillaries remain about the same.

*After 3 months:* The treated area can still be outlined; the capillaries are decreased in number compared with the normal picture; they appear dilated, however, and somewhat longer (Fig. 12).

*After 6 months:* The pigment is almost

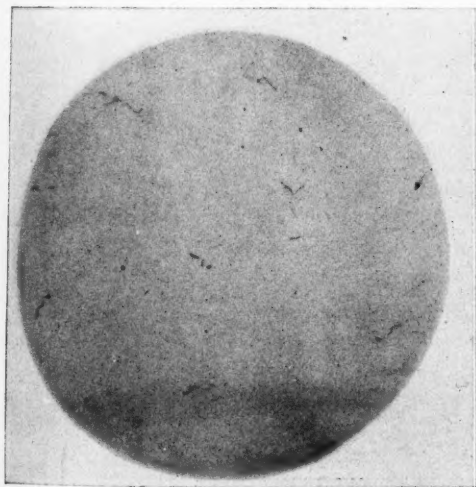


Fig. 4. Forty-eight hours after the exposure.

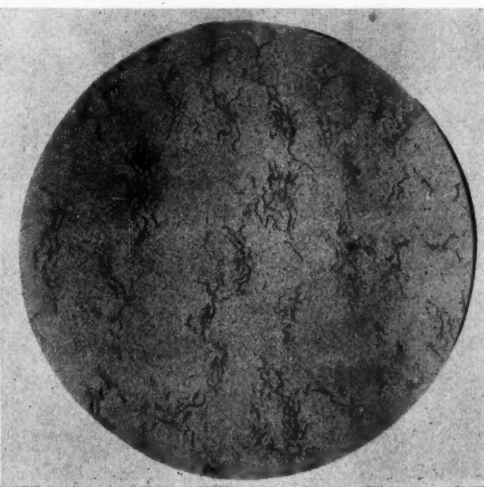


Fig. 5. Seventy-two hours after the exposure.

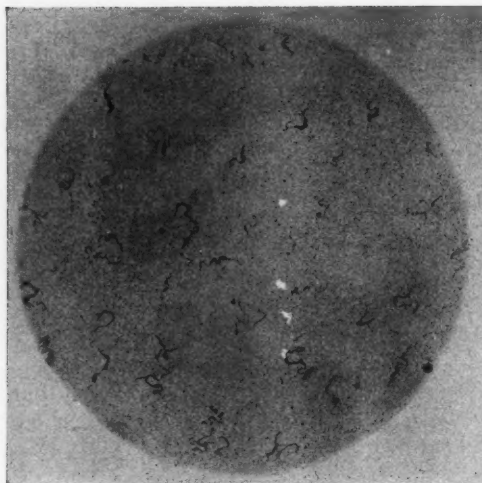


Fig. 6. Ninety-six hours after the exposure.

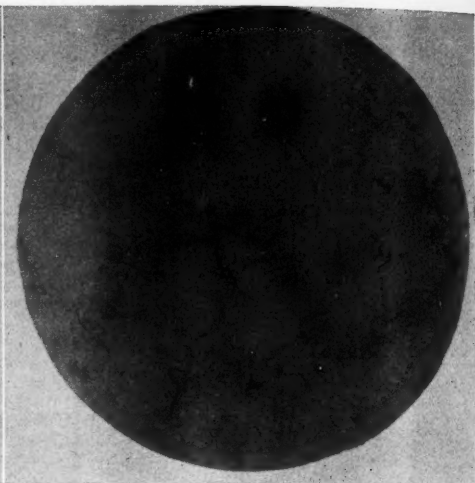


Fig. 7. Six days after the exposure.

gone; it can be made visible very easily, however, in a hot bath; the capillaries appear the same as in the previous slide; their walls seem to have thickened and their reaction to heat and cold is somewhat slow.

*After 1 year:* This slide shows a capillary appearance which we believe to be a typical end-result of exposure to filtered ra-

diation of short wave length. There may be more or less capillaries in number, as compared with normal skin; they are thickened, elongated and non-reactive (Fig. 13).

*After 2 years:* This slide is taken from a patient who had received a full erythema dose over the abdomen two years and two

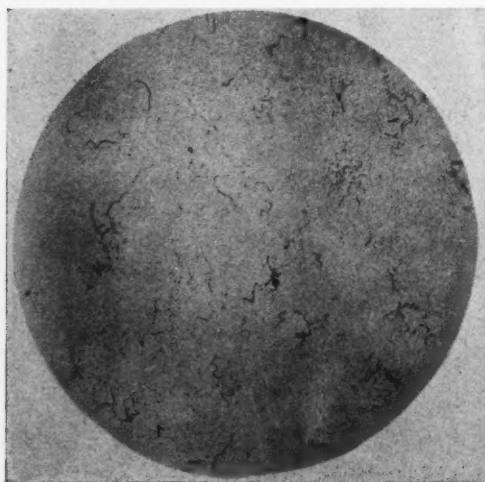


Fig. 8. Seven days after the exposure.

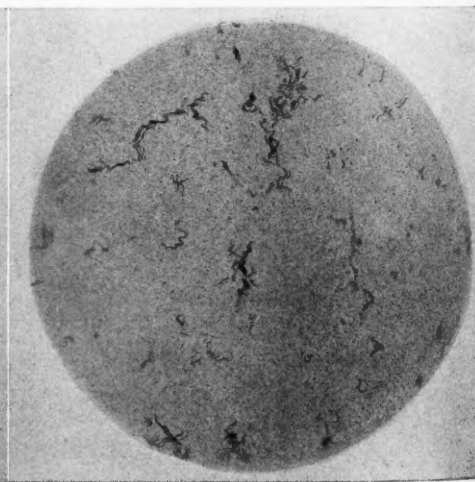


Fig. 9. Ten days after the exposure.



months before he came under our observation no treatment had been given in the interval. Figure 14 speaks for itself.

The visible skin reaction is recorded in Table I, based upon the following degrees:

Erythema

- (1) Just visible reddening.
- (2) Definite erythema.
- (3) Dark red.

Pigmentation

- (1) Faint tanning.
- (2) Definite tanning.
- (3) Dark brown.

TABLE I

Time	Erythema	Pigmentation
0 hours	—	—
6 hours	—	—
24 hours	—	—
48 hours	1	—
72 hours	1-2	—
96 hours	1	—
120 hours	?	—
6 days	1	—
7 days	2	—
10 days	2-3	—
3 weeks	1	>1
6 weeks	—	1-2
2 months	—	>1
3 months	—	1
6 months	—	?
1 year	—	?

Some investigators have also reported certain changes of the blood circulation in the capillaries after a roentgen-ray exposure. They do occur without doubt, but, due to the instantaneous character of these phenomena, we feel that only a cinematographic record will permit of a reliable analysis of their real nature.

2. Exposure to ultra-violet rays.

Probably the first author who studied the capillary changes following an exposure of the skin to the radiation of the quartz mer-

cury vapor lamp was Niekau, who worked under O. Mueller (7). It seems, however, that no systematic study of the capillary changes following the administration of an erythema dose of ultra-violet radiation until its complete disappearance was undertaken. We were also interested to see if this reaction appears in cycles similar to those after roentgen-ray irradiation.

The type of lamp used was a quartz mercury vapor burner connected to 110 volts A. C. "The Ultra-violet Unit" (medium erythema dose) in 50 cm. burner skin distance corresponded to  $3\frac{1}{2}$  minutes according to a photochemical test (8). The most effective wave length as far as the visible skin reaction is concerned has been found by Hausser and Vahle (9) to be at 2,970 Ångström units.

In the case which will be illustrated here, the flexor side of the upper arm was exposed to one ultra-violet unit. Regarding the definition of this unit, we refer to the previously mentioned paper (8). The capillary appearance of the area before treatment is given in Figure 15.

*After 2 hours:* There is a definite increase of the superficial capillaries; the background appears of a deeper red than before (Fig. 16).

*After 6 hours:* The skin erythema has fully developed; at the same time, the reserve capillaries appear in the field and the sub-capillary layer is visible. This stage lasts from four to ten hours and then gradually subsides (Fig. 17).

*After 24 hours:* The erythema is still apparent; the capillaries are increased in number (Fig. 18).

*After 48 hours:* A very slight tanning of the exposed field has appeared; the background in the microscopic field is yellow-red; the capillaries show a tendency to return to normal conditions (Fig. 19).

*After 2 weeks:* Macroscopically, there is hardly any change when compared with the

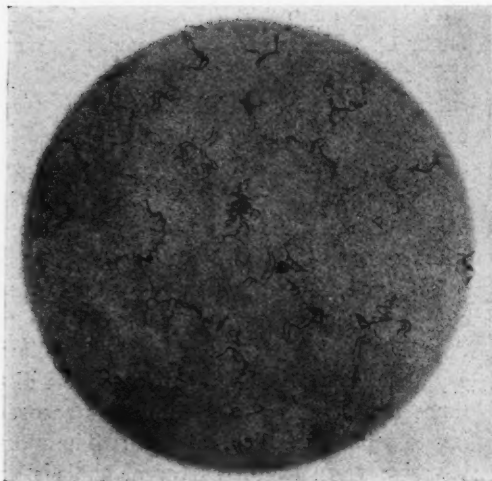


Fig. 10. Three weeks after the exposure.

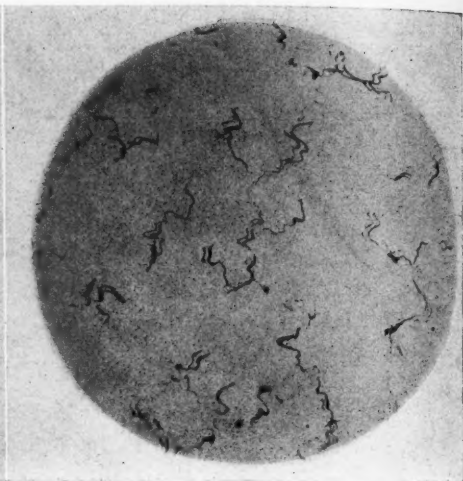


Fig. 11. Six weeks after the exposure.

normal skin; the capillaries have resumed their original appearance.

The macroscopic reaction is recorded in Table II.

TABLE II

Time	Erythema	Pigmentation
0 hours	—	—
2 hours	1	—
6 hours	2	—
24 hours	1-2	—
48 hours	1	>1
1 week	—	1
2 weeks	—	?

## DISCUSSION

Our observations seem to indicate that after the application of one erythema dose of filtered roentgen rays of short wave length, no complete recovery of the injured small blood vessels in the skin takes place. This differs, somewhat, from the statements made by previous investigators (David and Gabriel, 10, and Schugt, 11). Whether this may be due to a difference between the erythema dose of other investigators and our own, is hard to tell, as the

exact comparison of the various erythema doses in general use must still be regarded as a pending problem; it is in sharp discrepancy with the findings reported in our first paper concerning the erythema following unfiltered roentgen-ray exposure. We believe that even a year after the administration of a full erythema dose, or at least after what we consider at present, in our laboratory, to be the erythema dose, signs of a permanent injury to the capillaries are evident. They usually seem to be decreased in number, elongated, the wall thickened, the diameter larger; they respond somewhat slowly to heat and cold. There is no doubt that after a dose of this type of radiation has been repeated once or several times, these changes must be much more pronounced. That explains, perhaps, the fact that late reactions after roentgen exposure appear chiefly following a dose high enough to cause a permanent injury of sufficient degree to the small blood vessels. Miescher (12) has shown, when studying the changes taking place in irradiated tissue histologically, that even after years there are still signs of injury due to the previous irradiation.

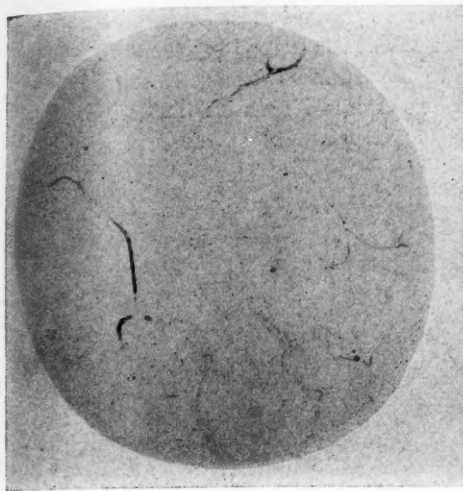


Fig. 12. Three months after the exposure.

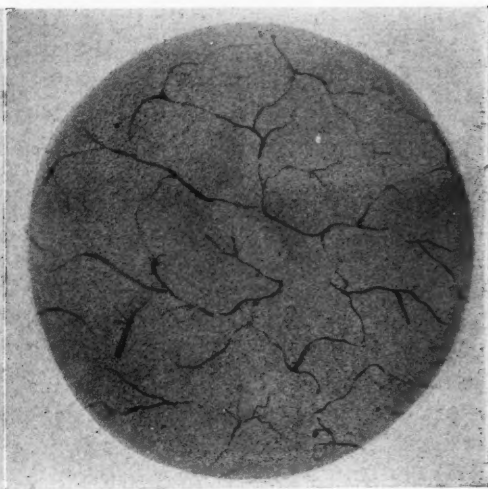


Fig. 13. One year after the exposure.

tion. He suggests that this fact offers an explanation for the observation that a small insult to such injured tissue suffices to cause the appearance of a late reaction, manifesting itself in a roentgen ulcer. We see here, then, the first possibility of using capillary microscopy for the control of the so-called erythema dose. This erythema dose, better spoken of as the *tolerance dose*, should be only so potent that a complete recovery of the capillaries may take place in from three to five months following the exposure.

The capillary changes following an exposure to one ultra-violet unit are very similar to those seen after the administration of unfiltered roentgen rays. The reaction differs distinctly, however, in two points. It is evident from the illustrations of the microscopic reaction and also from the table giving the details of the macroscopic reaction that ultra-violet rays cause a very brief and only temporary capillary disturbance after a single exposure; there is only one cycle. Long continued treatment may perhaps lead to chronic changes (Mueller). In view of the clinical investigations of McKee and his co-workers (13) concerning the ultra-violet

rays as a prophylactic against radiodermitis—they came to a negative result—it will be worth while to study the capillary changes taking place under the influence of combined roentgen rays and ultra-violet rays. This would also bring, perhaps, an explanation for the animal experiments of Pfahler and his co-workers (14), who

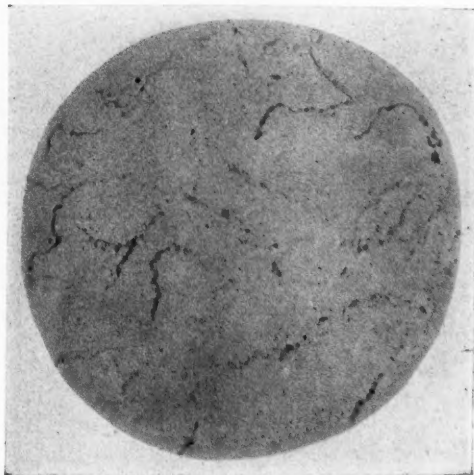


Fig. 14. Two years and two months after the exposure.

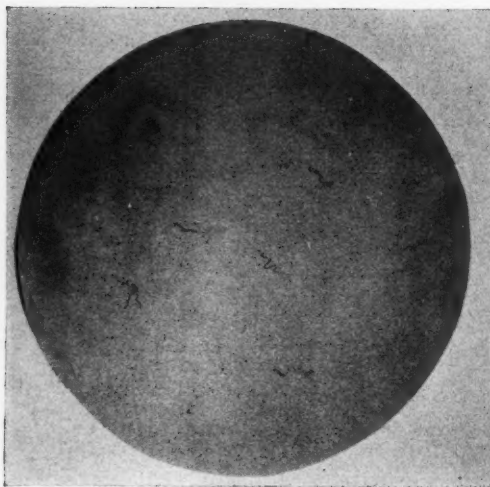


Fig. 15. Before exposure to ultra-violet rays.

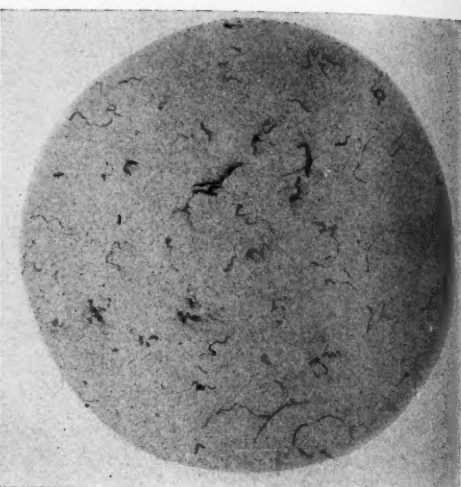


Fig. 16. Two hours after exposure to ultra-violet rays.

found that ultra-violet rays enhance the effect of roentgen rays.

The macroscopic and microscopic changes ran parallel for both types of erythema, *i.e.*, after exposure to roentgen rays as well as to ultra-violet rays. The capillary reaction always precedes the visible skin reaction to

some extent, or, in other words, it is possible to predict an erythema by capillary microscopy before it is visible on the skin.

It was mentioned in the discussion of the first paper that we might employ the capillary microscope in practice to help us decide the question as to when to repeat an

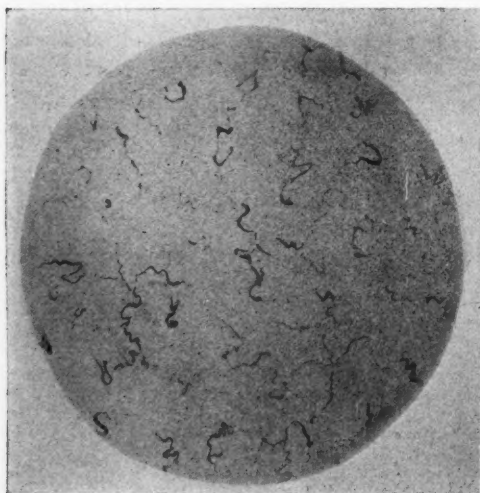


Fig. 17. Six hours after exposure to ultra-violet rays.

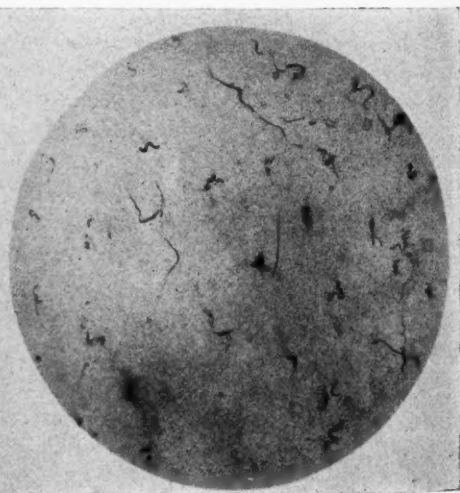


Fig. 18. Twenty-four hours after exposure to ultra-violet rays.



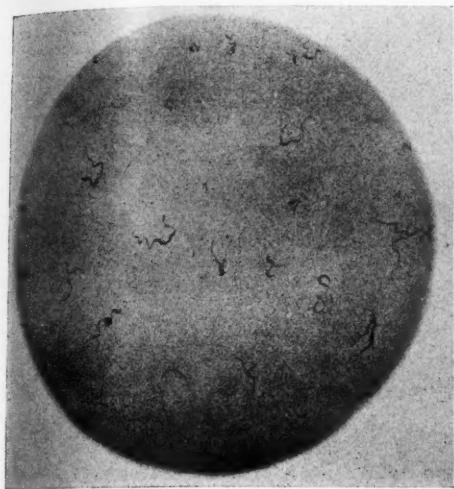


Fig. 19. Forty-eight hours after exposure to ultra-violet rays.

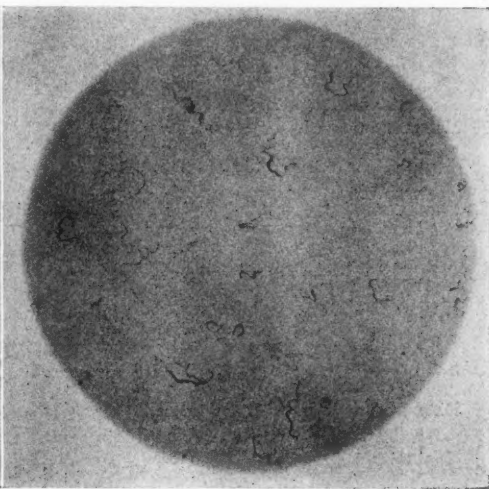


Fig. 20. Two weeks after exposure to ultra-violet rays.

X-ray treatment, particularly in cases which have had irradiation in another laboratory. This method may prevent undesirable reactions. One can go further. Welsch (15) has suggested to give a so-called test exposure with ultra-violet radiation to patients under suspicion of hypersensitivity to roentgen rays, and to base the decision regarding the dose upon the behavior of the capillaries following this exposure. Clinical experience on a broad basis will show how much benefit may be gained from this method. In view of the numerous late reactions after radiation therapy, certainly nothing should be left untried that suggests help in their prevention.

#### SUMMARY

1. Studies of the skin capillaries after the administration of one erythema dose of roentgen rays of short wave length seem to indicate that complete *restitutio ad integrum* does not take place.

2. The microscopic and macroscopic changes appear in cycles (Miescher); in

most cases there is, however, no sharp interval between consecutive periods.

3. A single exposure to ultra-violet rays (one ultra-violet unit = one medium erythema dose) produces capillary changes similar to those following unfiltered roentgen rays but for a shorter period of time, with complete recovery in from two to three weeks.

4. Further investigations dealing with the combined effect of roentgen rays and ultra-violet rays and repeated exposures on the skin capillaries will be reported in a third paper.

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## WHAT EVERY RADIOLOGIST SHOULD KNOW ABOUT BONE TUMORS<sup>1</sup>

By JOSEPH COLT BLOODGOOD, M.D., BALTIMORE, MD.

THE X-ray is becoming more and more the instrument of precision for the diagnosis of diseases of bone. When this fails, biopsy, properly performed, may become the next means of accurate diagnosis. Nevertheless, we must recognize cases in which the diagnosis cannot be made by the X-ray and for which it is safer to try the therapeutic value of radiation without biopsy.

Recent experience allows a recasting and rearrangement not only of diagnostic problems, but of therapeutic indications. At the same time that we attempt to picture new knowledge gained by this vast experience, we must not neglect to record again and again the fundamental principles and the older knowledge which still stand true after this test of longer experience.

There is no logical way to take up the new and the old, and, as it may not be possible to cover the ground, I will try to discuss first the controversial problems in relation to both.

*Radiation versus Curetting or Resection in the Benign Giant-cell Tumor.* Up to 1923 (*Annals of Surgery*, May, 1923, XXXVII, 105), a group of students of bone tumors were attempting to show that a giant-cell tumor is not a sarcoma, and that curetting would accomplish a cure just as well as amputation, and resection could be performed when the resultant function was equal to curetting, or where the bone shell was so completely destroyed that bone transplantation was indicated to restore function.

Three years ago this had practically been accomplished, and the percentage of curettings had risen from less than 5 to more than 60 per cent. Nevertheless, even today, there are pathologists who still look

upon the giant-cell tumor as a sarcoma and naturally urge the surgeon to amputate. Between 1920 and 1925 some surgeons curetted with timidity and would not depend upon thermal and chemical cauterization alone, but introduced radium into the bone shell. Unfortunately, in this group there was a large number of cases of post-operative infectious osteomyelitis, resulting either in amputation or a loss of function due to necrosis.

In addition, when the curetting was not thoroughly done and when thermal and chemical cauterization were omitted, there were fairly numerous recurrences. These results naturally influenced the less experienced group against curetting, against curetting with radium into the cavity, and naturally there followed an attempt to get results without amputation by trying radiation first.

I have seen a large number of giant-cell tumors subjected to thorough radiation. There is no question but that it is better than amputation. These patients are living today; many have useful limbs. In some cases in which the X-ray pictured a partial destruction of the bone shell, there has apparently been a reossification of the destroyed area. Nevertheless, in not a single instance have I seen a roentgenograph showing complete ossification of the central tumor in the epiphysis. On the other hand, I have seen the bone shell disappear under radiation. In three giant-cell tumors of the lower jaw and four of the epiphysis of the long pipe bones, I had the opportunity to curette the tumor after a thorough course of radiation, lasting from a few weeks to almost one year; in not one of these cases was there any ossification of the soft tumor mass. In some, there was slight evidence of bone formation in the shell. In not one

<sup>1</sup>Paper read before the Clinic at the Annual Meeting of the Radiological Society of North America, at Milwaukee, Nov. 29-Dec. 4, 1926.

of these cases was any harm done, so far as cure was concerned, by the pre-operative X-ray treatment. In every case time was lost, and in a few the bone shell was less intact after radiation than before. There is no evidence to cause one to believe that the therapeutic rays destroyed the bone shell, but there is certain evidence that they did not prevent its destruction through pressure atrophy by the further growth and expansile pressure of the tumor.

I am not prepared to prophesy what the ultimate treatment for this benign giant-cell tumor will be, but at the present writing, based upon more than 250 observations, I have positive evidence that curettement, properly performed, with thermal and chemical cauterization, should yield practically a cure in every case in the shortest space of time with the best functional result.

When the central epiphyseal tumor comes under observation with an intact bone shell, it seems to me nothing can be gained by radiation, as the intact bone shell makes it an ideal one for immediate curettement. On the other hand, if the bone shell is partially destroyed, radiation may be tried first and continued, if roentgenographs show evidence of ossification of the bone shell. However, I incline to the conclusion that the ultimate permanent cure is best and most quickly accomplished by curettement.

From my own cases and from all the written descriptions by others, one must expect temporary increase of pain, swelling and edema after radiation; these are followed by the disappearance of edema and pain and a definite contraction of the expansile tumor, but only in a very few instances by ossification of the destroyed areas in the bone shell.

Radiation is a great advance over immediate operation for biopsy when the operator and his clinic are not prepared to make the immediate diagnosis, and therefore the wound must be closed, followed by a delay for the pathological diagnosis. Biopsy has

an element of danger in all tumors. Radiation, while waiting for consultation on the result of the X-ray examination, is a very safe procedure, and radiation undoubtedly has indirectly prevented indiscriminate exploration and unnecessary amputations. But I wish to bring before the roentgenologists here that radiation alone for giant-cell tumors is in its experimental stage, and there are many fundamental and well-established correct observations which indicate that it is safer to explore central epiphyseal tumors, even if they apparently react favorably to radiation after the first short stage of increased pain and swelling.

*Central Tumors of the Epiphyseal End of Long Pipe Bones, Jaw Bones and Others.* Metastatic tumors rarely appear in the epiphysis, and I have never observed multiple myeloma to appear with an involvement of the epiphysis of only one bone. The common tumor of the epiphysis of long pipe bones is the giant-cell tumor. But there may be chondroma, myxoma, chondromyxosarcoma, the latent or unhealed bone cyst, a single caseous tubercular area, a rare Brodie abscess of chronic osteomyelitis. I have cases of chondroma, myxoma, chondromyxosarcoma which have been subjected to persistent radiation without any effect on the vitality of the tumor tissue. In my opinion this is evidence in favor of exploring central tumors of the epiphysis, because these other tumors, when the bone shell is intact, offer an ideal stage for a permanent cure after eradication with thermal and chemical cauterization, and if a bone cyst, Brodie abscess, or caseous tubercular area is revealed, much time is saved in the proper treatment of these very benign conditions. When one allows central bone conditions with intact bone shell, with or without radiation, to proceed to the partial or complete destruction of the bone shell, the permanent cure with good function in all the benign lesions is made more difficult, and this procedure leads to radical resection or



even amputation in the sarcoma, the myxoma, and, in some instances, even in the chondroma. Therefore, I would urge immediate exploration in all central lesions of the epiphysis in which the bone shell is intact. On the other hand, if the bone shell is partly or completely destroyed, there is no objection to giving the patient the benefit of radiation first. I have seen no evidence to prove that it will be beneficial in any except the benign giant-cell tumor. If the bone shell is intact, one might say, "Let us try radiation first, and then, if there is no improvement, curetting." But the bone shell may disappear so quickly that it is impossible to foretell it even with repeated X-ray examinations.

In the phalanges and in the metacarpal and tarsal bones, the giant-cell tumor is less frequent than the chondroma; therefore there is no theoretical advantage in radiation first. These bones are so small and they are so quickly destroyed by any type of tumor, and they are so difficult to restore perfectly by bone transplantation, that nothing seems gained by delay. In a very young person one might watch a case with frequent X-ray examinations.

In the lower jaw, the central giant-cell tumor is a rarity; the common lesions are the dentigerous cyst and the adamantinoma. Neither can be cured by radiation. Then there is the fibroma which has a tendency to become fibrosarcoma. Even here we must reckon with a malignant sarcoma. The only opportunity for curing such a sarcoma is in its early stage when it is still within the bone shell and can be destroyed with the cautery. For central tumors of the lower jaw, therefore, nothing, in my experience, is gained by radiation first. When the shadow is like that of a root abscess and involves one or more dental roots and the teeth are still fairly firm, and there are no systemic symptoms, radiation may be tried first.

*Radiation versus Exploration or Non-interference in Central Tumors of the Shaft.* In children and young adults under eighteen years of age, central tumors of the shaft of long pipe bones are due to osteitis fibrosa or bone cysts. There is no evidence that spontaneous ossification is at all helped by radiation. Nor, in cases of delayed ossification, have I ever seen any results from X-rays or radium. These children need a special diet, which has proved efficacious in rickets, and if, in addition, there is a fracture, spontaneous ossification is rapid. When there is no fracture, and the roentgenograph shows no evidence of ossification or further expansion of the bone shell, there should be immediate operation, the chief object of which is to produce a fracture—a comminuted fracture by crushing the bone shell is best. Of course, the tumor must be explored first and its pathology established.

In the central tumors of shafts in adults the bone cyst is less frequent, and we must think of chondroma and myxoma and the sarcoma which may develop in either. Then there is always the possibility of the solitary metastatic lesion or the multiple myeloma. Here nothing is gained by radiation when the bone shell is intact. The tumor must be explored. Curetting, resection with bone transplantation, or even amputation depend upon the nature of the central lesion and the extent of the involvement of the shaft. I will discuss this later under X-ray diagnosis.

*X-ray Diagnosis of Central Lesions.* If you will place together the roentgenographs of every type of pathological process that may produce destruction of the marrow cavity in the shaft, of the cancellous bone in the epiphysis or the flat bones, you will find it almost impossible to distinguish one from the other. In all, I find examples of intact bone shell; in all, there may not be the slightest evidence of bone formation outside the bone shell. When there is evidence of bone formation outside the bone

shell, this suggests a chondroma, chondrosarcoma, or metastatic tumor. The destruction of the bone shell in the giant-cell tumor, the bone cyst, the chondroma and the myxoma is practically identical in the X-ray film, but often in the metastatic tumor along with pressure destruction—which leaves a bone shell smooth like an egg shell—there is porous destruction of the cancellous and cortical bone above and below the central cavity due to infiltration of tumor tissue outside the central mass. That is, we have pictures of metastatic carcinoma that are never seen in the bone cyst, chondroma, giant-cell tumor or myxoma. But, nevertheless, when the lesion is a single one, it is very difficult to make a differential diagnosis from the X-ray examination. The earlier the lesion and the more intact the bone shell, the greater the difficulty of differentiation. Again, when the bone shell is being destroyed, the giant-cell tumor by invading the shaft from the epiphysis may produce a picture of destruction without bone formation that is impossible to distinguish from sarcoma. All of these possibilities, based upon positive evidence, show how important it is to continue to critically restudy old roentgenographs and to compare them with the films of new cases in the hope that we may discover differential points. It would be most satisfactory to be able to differentiate, for the reason that in some central bone tumors, especially the myxoma and sarcoma, it would be very desirable to resect without exploration, and, in some cases, even to amputate. The objection to biopsy is the technical difficulty of making an immediate frozen section and the practical one of getting into our operating rooms pathologists trained in frozen-section diagnosis. In the majority of surgical clinics to-day the diagnosis of bone lesions from the roentgenograph is more advanced than the diagnosis at biopsy.

*Multiple Central Bone Lesions.* We can be quite certain that if the multiplicity is as-

sociated with the malignant types, such as myeloma and metastatic carcinoma, there can be no cure. However, there are benign and curable forms of multiple central lesions of the shaft. At the present time there is no positive X-ray differentiation in many of the cases, and biopsy may have to be resorted to. This is justifiable.

*The X-ray Diagnosis of Periosteal and Diffuse Lesions of Bone.* The terms "central" and "periosteal" are well established in the literature, and also well established in X-ray examinations, but there is a third group to which neither of these terms can be applied. The entire shaft or the entire bone area is involved in the process of bone formation or bone destruction, or both. The term "periosteal" or "central" does not describe the X-ray film. We do not know whether the lesions are of central or periosteal origin. When they come under observation, there is only one word which up to the present time I have been able to find which will describe the lesion and that is *diffuse*. Sclerosing sarcoma and sclerosing osteomyelitis represent benign and neoplastic processes that are always diffuse. In these two now well-established groups bone formation or increased fibrous tissue, both endosteal and periosteal, predominate in the picture. Actual bone destruction is present only in the later stages, and sequestrum formation is observed only in the very late stage or not at all in the sclerosing osteomyelitis. I have seen numerous cases of sclerosing sarcoma in which a positive diagnosis of malignancy could be made from the characteristic roentgenograph. In sclerosing osteomyelitis, the number of characteristic pictures in which a positive diagnosis can be made without the evidence of sequestration in the X-ray, is unfortunately less, and the number of cases of sclerosing sarcomas and sclerosing osteomyelitis in which a differential diagnosis in the roentgenograph can not be made with certainty is increasing, so much so that the diagnostic

procedure when resection or amputation is a method of choice for sarcoma, is biopsy, and biopsy only.

There is a second form of the diffuse lesion in which, throughout the shaft, a sponge-like, or worm-eaten-like picture is seen, irregular in outline, resembling the osteoporotic rarefaction of non-use. If one will palpate carefully and get X-ray exposures from more than one direction, as a rule one can make out some thickening of the periosteum in which there may or may not be bone formation. Most of these diffuse forms of osteoporosis are sarcoma, and, usually, microscopically, of the so-called Ewing type. They may be multiple, and are entirely different in the X-ray examination from the true multiple myeloma, which gives the picture of a central lesion. Now and then metastatic carcinoma may show this diffuse picture of osteoporosis. The second stage of the sarcoma of the osteoporotic type is definite bone destruction, which always can be recognized as malignant in the X-ray examination, when it involves the shaft. But when it involves the epiphysis and the shaft, as already recorded, there is a possibility of the benign giant-cell tumor. In the rarest of instances, osteitis fibrosa may give this picture in the shaft, and there is no way of making differentiation from sarcoma except by biopsy.

When this osteoporosis involves a small zone of cortical bone, and the cancellous bone beneath, and is associated with a little bone formation on the periosteal side corresponding with the area of bone destruction, there is no positive way of differentiating sarcoma from osteomyelitis. Therefore, just as there is a benign and malignant sclerosing diffuse lesion, there is a benign and malignant osteoporotic lesion, and with both there may be definite periosteal bone formation, or there may be no evidence or very little of periosteal bone formation.

Periosteal bone formation without changes in the shaft beneath can be as-

sociated with a distinctly benign process which may be called traumatic or infectious ossifying periostitis, or it may be a definite primary sarcoma—neoplastic ossifying periostitis. Therefore, the effect of trauma, lacerated tissue and blood, the presence of bacteria, or the presence of sarcoma cells may produce bone formation, and for practical purposes this bone formation may be identical. In addition, we have to remember that traumatic ossifying myositis may rest upon the shaft of the bone and become in the X-ray film indistinguishable from traumatic, infectious and neoplastic ossifying periostitis.

*The Mode of Procedure when the X-ray Examination does not Allow a Differential Diagnosis between Benign and Malignant, Periosteal and Diffuse Lesions of Bone.* In the first place, the mode of procedure depends upon the choice between radiation and amputation for a malignant disease of bone. If radiation is to be the choice, no matter what the location of the disease, then there is no indication for biopsy. But if one agrees that in situations below the upper third of the femur amputation offers more for a permanent cure than radiation, then there must be biopsy before amputation may be performed. If one feels that resection of the lesion of a bone of the upper extremity offers more than radiation, then there must be biopsy before the resection is done.

My evidence—and, I believe, the evidence accumulated by Codman in his registry of bone tumors—clearly indicates that up to the present time practically the only verified cures of sarcoma of bone are those which have followed amputation for lesions of the lower extremity below the upper third of the femur. In my own list of cases and in those accumulated by Codman, there are no verified cases in which cures have followed amputations of the upper extremity or of lesions of the upper third of the femur. In these regions, if resection with restoration

of function cannot be done, then there must be radiation.

*Biopsy.* Biopsy is not a radiological problem: it is entirely one of surgical pathology. I have just discussed it in the

nant, and, if so, to proceed at once with the resection or amputation.

I feel, however, that radiologists should be given an opportunity to submit their difficult-to-diagnose films of bone lesions to



Fig. 1, Path. No. 27,964. X-ray diagnosis, April, 1921, periosteal sarcoma. Periosteal tumor, no bone formation. Shaft shows area of bone destruction. Treatment: Radium—Dr. Curtis F. Burnam, Baltimore. Result of treatment, see Figure 2.



Fig. 2, Path. No. 27,964. X-ray film, May, 1921, twenty-one days after the first radiation and five days after the last radiation. Almost complete disappearance of the periosteal growth, and better function at joint. For result three years later, see Figure 3.

Chairman's Address before the Surgical Section of the Southern Medical Association and those remarks will shortly be published in the *Southern Medical Journal*. But I will say now that in the past six years I have performed biopsy on practically every type of benign and malignant lesion of bone, whether central, periosteal, or diffuse, in order to decide whether it was malig-

other diagnosticians before the biopsy is undertaken by the surgeon. This is based upon the well-recognized fact that biopsy has some elements of danger, especially when the wound is closed and there is an interval of time before malignancy is recognized.

*Radiation.* Up to the present time I have had one case of a periosteal and diffuse sarcoma of the upper shaft of the humerus which has remained well for almost six years. It is true, that five years after radiation I removed the right kidney for a



hypernephroma. The original lesion of the shaft of the humerus did not, in the X-ray examination, resemble a metastatic tumor. In fact, from the roentgenograph, there could be but one diagnosis—a periosteal unossified tumor, with some destruction of the shaft in the early osteoporotic stage (Figs. 1, 2 and 3).

There have been two cases in which X-ray treatment was chosen because the lesion in one was in the upper third of the femur and, in the other, in the scapula. From a roentgenograph it is impossible to be certain of the character of the lesion. The one situated in the upper third of the femur had, on palpation, the spindle swelling surrounding the shaft, usually present in sarcoma and rarely observed in osteomyelitis. The bone changes revealed by the X-ray could have been associated with those of a periosteal sarcoma in which there was very slight periosteal bone formation and definite destruction of the cortical layer and cancellous zone of the osteoporotic type. Nevertheless, osteomyelitis could not be excluded. In this patient, within one year, there was fistula formation and the discharge of a small sequestrum. In the second case, the roentgenograph and palpation strongly suggested sarcoma: the later fistula formation, with the discharge of a sequestrum and the still persisting fistula, favored osteomyelitis or tuberculosis. It is almost five years since the beginning of treatment in these two cases.

Radiation by radium and X-rays has been persistently employed in many cases of sarcoma of bone, either without any operation, or preceding amputation or resection, but with the exception of these three cases there are no cures and no definite results. In addition, myxoma and chondroma have been exposed to repeated and prolonged radiation without results. In my experience, radiation of sarcoma of bone has had less beneficial effect than radiation of sarcoma of

the soft parts. But the one case again reported here, now living six years after radiation, indicates that now and then it may be successful. There is no harm in radiation preceding operation, while the X-ray film is being submitted to a number of diag-



Fig. 3, Path. No. 27,964. X-ray examination April, 1924, three years after first treatment. There is complete atrophy of the deltoid muscle and some restriction of motion in joint. The areas of bone destruction in the shaft have ossified. The areas of rarefaction in the head have increased, probably due to non-use. X-ray film made in 1926; no further change. For full history, see text, page 200.

nosticians for help; but if the lesion be situated in an operable zone, nothing is gained by delaying operation.

*Radiation in Multiple Myeloma and Metastatic Carcinoma.* I have observed temporary curative effects in Ewing's type of sarcoma, but no permanent cures. In the true multiple myeloma, with Bence-Jones bodies in the urine, no evident effect of radiation; in multiple bone tumors from hypernephroma, no effects; in metastatic

carcinoma to the vertebrae with pain and even with inability, on account of pain, to move or sit up, there usually has been immediate relief of pain and gradual restoration of function. In a few, apparent ossification of destroyed vertebrae took place. In one patient there was relief temporarily from three definite attacks, the longest interval of time being two years. In other forms of metastatic carcinoma of known primary origin in the breast, or established by biopsy, there seems to have been some temporary beneficial effect, but there are no cures by radiation of multiple malignant bone tumors.

*Amputation.* The most encouraging evidence for possible increase in the number of cures of sarcoma of bone by amputation is the increasing number of five-year cures, since 1921, following amputation for lesions below the upper third of the femur. When I made my report in 1921 there were but two five-year cures: in both, the amputation had been performed in 1913. Why were there no cures previous to 1913? The only explanation is the recorded and well-known late amputation. Since 1918 there has been a larger number of amputations within short intervals after the first symptoms, and earlier intervention is the only explanation of the definite increase from less than 8 to more than 20 per cent of cures. It has been the most gratifying surprise since my publication in 1921 to hear from these patients, who have lived and are still living five years after amputation. But recently, there has appeared one five-year cure after an amputation for a sarcoma of the upper extremity—the first to be observed in the cases studied by me. In view of these facts, the importance of biopsy increases, and surgeons and pathologists must prepare themselves for this method of immediate diagnosis when the X-ray fails to allow a definite conclusion.

*Resection.* In the past three years four cases of sarcoma of the upper extremity

have come under my observation in such early periods that although we have been unable to make a positive diagnosis from the roentgenograph, we were able to do so at biopsy and to resect. These patients now are apparently well and have limbs with good function. Here, again, we have evidence of the good effects of educating the public. Where before, sarcoma of the upper extremity came under observation when amputation only would remove the disease and yet not accomplish a cure, now we know that at least we may expect to observe these cases when resection is possible and restoration of function usually possible by resection, and there is hope that the probability of a cure may be almost as good as that which we have accomplished by amputation for similar lesions in the lower extremity.

*Conclusions.* What is most needed is a more universal comparative study of the X-ray findings. There is ample room to improve our diagnostic abilities. Second, radiologists should publish in detail case reports of the central tumors of the epiphyses which are apparently well after radiation, especially in relation to function and duration of time. I am unable to get sufficient material to make a just comparative study with curetting. Third, in all those operating rooms in which these operations upon doubtful bone tumors are being performed, there must be provision for biopsy, and surgeons must learn to perform biopsy under the protection of thermal and chemical cauterization, the object of which is to prevent contamination of the wound with tumor cells. Pathologists, likewise, should train themselves to make the differential diagnosis from the fresh frozen section, so that, if possible, the amputation or resection for the malignant disease, if present, can be performed at once. The greatest danger from biopsy is the interval of time between the exploratory incision and the resection

or amputation, if the disease be malignant. There is no doubt that when the exploratory incision is made with thermal and chemical cauterization and that when the wound is packed with a piece of gauze wet in 50 per cent zinc chlorid solution and the skin closed over it, the dangers of biopsy may be eliminated if the time is kept within a few days or a week. Fourth, if there is any

doubt from the X-ray film or from the microscopic study as to definite malignancy, it is safer to treat the condition as innocent, because the element of error is largely in favor of benign conditions, and the probability of curing the malignant is as yet far too small to justify amputation or resection unless the diagnosis of malignancy is as certain as it is possible to make it.

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## X-RAY THERAPY IN SKIN MALIGNANCIES<sup>1</sup>

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**R**ADIOTHERAPY won its first applause in the treatment of skin cancer. In the *Transactions of the American Roentgen Ray Society*, for 1902, there appears a paper by Dr. John B. Murphy, entitled "The Roentgen Ray as a Therapeutic Force from a Clinical Standpoint, with Illustrative Cases." At this

case of epithelioma of the eyelid that was entirely relieved. In commenting on this case Dr. Murphy said that it was one of the most perfect repairs he had ever seen.

The *Transactions* of the same Society for 1905 contained an illustrated article by Dr. E. G. Williams, of Richmond, Va., from a Symposium on Malignant Disease. Photo-

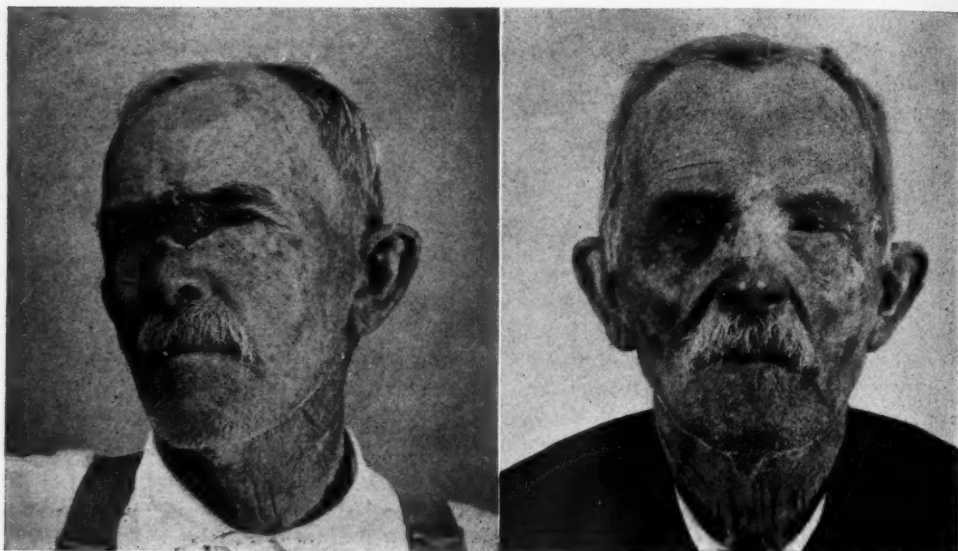


Fig. 1. Farmer, age 67. Was first seen September 12, 1921. Family history negative. The growth began fifteen years before in inner corner of left eye. When treatment was begun (Fig. 1A, left) ulcer covered entire bridge of nose between eyes. Edges of ulcer were irregular, indurated and elevated. Clinical diagnosis was basal cell carcinoma. Treatment consisted of ten erythema doses of X-ray, given in five exposures. Lesion healed promptly and there was no evidence of recurrence January 1, 1924, the date of last report (Fig. 1B, right).

time Dr. Murphy did not speak encouragingly of the X-ray treatment of deep-seated malignant lesions, but he refers to cases of superficial epithelioma that were successfully treated by X-rays and cites one

graphs of several cases of carcinoma of the skin were included. The end-results were most excellent and probably have not been improved on to this day.

In the earlier days we were frequently favored with splendid articles on the subject by Johnson, Boggs, Grubbe, Leonard, Pusey, Stover, Pfahler and many others, a

<sup>1</sup>Presented before the Joint Meeting of the Radiological Society of North America, the State Medical Society of Wisconsin, the Medical Society of Milwaukee County and the Milwaukee County Radiological Society, Dec. 1, 1926, at Milwaukee, Wis.



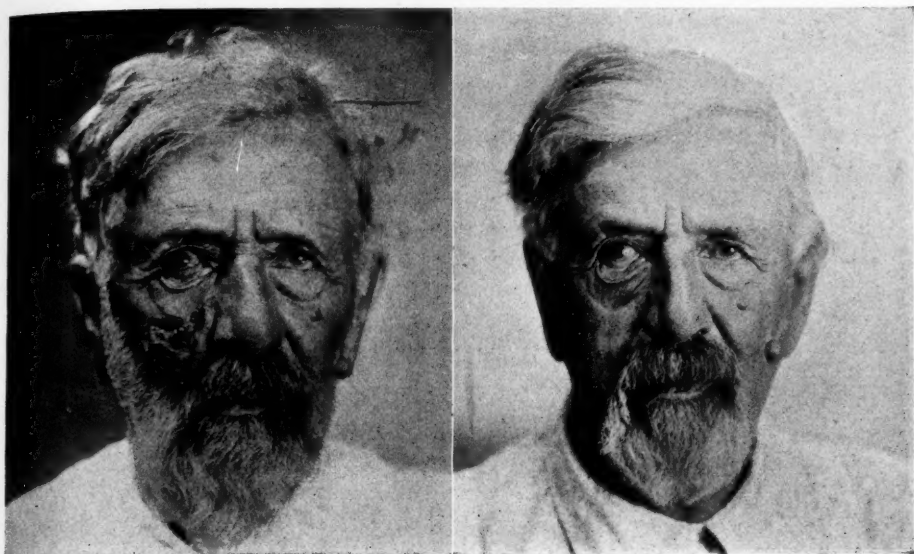


Fig. 2. Farmer, age 78. Was first seen August 11, 1920. Family history negative. In 1916 a wart-like growth appeared on right cheek. Growth was rapid. At the time of treatment the lesion was about one by two inches in size, deeply ulcerated, with a hard thick border (Fig. 2A, left). Clinical diagnosis was basal cell carcinoma. Six double erythema doses caused lesion to heal (Fig. 2B, right). In 1922 recurrence appeared in lower border of former lesion. He was persuaded to consult an osteopath who was a disciple of Abrams. His condition grew rapidly worse until he finally died.

few of whom are still living. Those days have passed and the good work that the pioneers did has been forgotten by many of the older men and never heard of by many of the younger radiologists of the present day.

With the advent of high voltage technic and the more spectacular deep therapy the simpler technic for superficial malignancies has been neglected by many of our best radiologists, until the successful treatment of skin cancer by X-ray methods has, in some sections at least, become almost a lost art.

My object, therefore, in presenting a paper on X-ray therapy in skin cancer is to stimulate interest among our younger men who have neglected this class of work for the deeper seated lesions. Deep therapy deserves every encouragement, but I feel that the more successful superficial methods have not been given the acclaim they merit and are not so extensively used as they should be.

Statisticians tell us that skin cancer is responsible for less than 4 per cent of our annual cancer mortality, but no attempt has been made to estimate the large number of cases treated and cured by the various more or less reliable methods in general use by the regular medical profession.

Cancer of the skin, being local, offers a better opportunity for early diagnosis and treatment than the deep seated lesions. This fact gives to the physician who treats skin cancer a considerable advantage by enabling him to show a high percentage of cures and a very low death rate, particularly in early cases. While no part of the skin is exempt from cancer manifestations, about 90 per cent of the lesions are located on the exposed parts, the face leading in point of frequency.

In the pre-radiotherapy days, surgery and caustics were the recognized methods of treatment. Almost every remedy in the

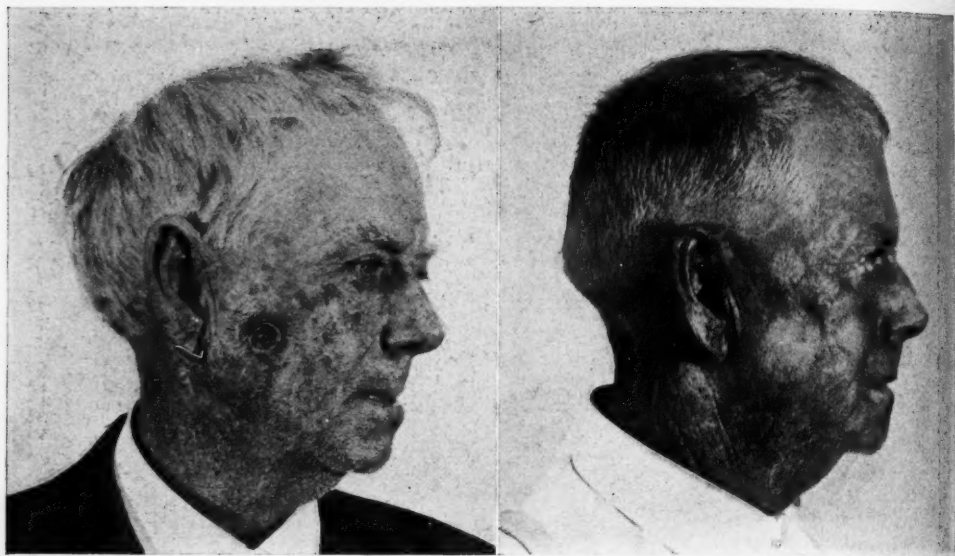


Fig. 3. Farmer, age 64. Was first seen January 6, 1925. Family history: Grandmother died from cancer of nose. Personal history: Seven years before he was first seen a scaly patch appeared on right side of face. Was treated with some sort of plaster. Two years before examination a papular growth appeared on site of former lesion. At time of his first visit there was an ulcerated lesion on side of face about the size of a twenty-five cent piece (Fig. 3A, left). Edges were elevated, indurated and rolled outward. Clinical diagnosis was basal cell carcinoma. Six double erythema doses of X-rays, through a cone three-quarters inch in diameter, caused ulcer to heal. The second photograph (Fig. 3B, right) was made December 27, 1925. At this time skin was soft and smooth over site of former growth.

pharmacopeia, at one time or another, has been used in the treatment of this dread disease. It is not surprising, therefore, that the newer methods of radiation were given a trial in order that they might show what they could do.

With little or no knowledge of the possibilities of the X-rays, with apparatus that was unreliable as regards the radiation produced and with no means of dose determination, the early treatment was a matter of speculation. A few cases responded in a surprisingly prompt and favorable manner. With this encouragement many physicians began the treatment of cancer with X-rays. Some good was accomplished, though many cases were made worse as a result of under- or over-treatment. When these conditions prevailed, X-ray therapy for cancer was discontinued as being unreliable or dangerous.

A few physicians who had carefully worked out a technic that was reasonably safe, continued the treatment, and as a result have been rewarded with many successful cures. With the general improvement of apparatus the technic has correspondingly improved, so that the determination of the size of the dose of X-rays to be administered to the skin is now sufficiently accurate for all practical purposes.

There are many cases of cancer of the skin that, because of neglect or improper treatment, cannot be cured by any method or combination of methods. There are, however, many cases of the so-called incurable type that can be greatly benefited, and a few cured, by a combination of the recognized methods. Therefore, anything that I may say in support of X-ray therapy in the treatment of skin cancer must not be

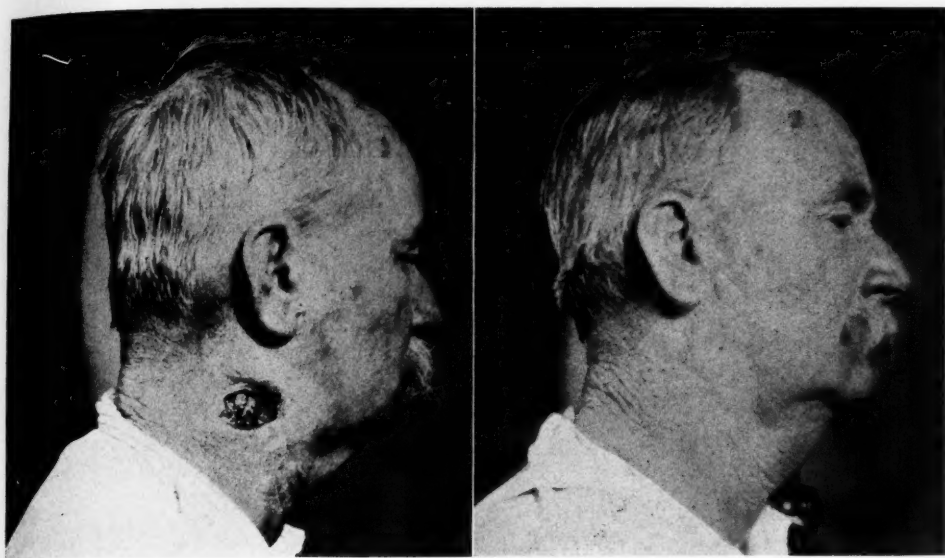


Fig. 4. Farmer, age 59. Was first seen February 22, 1919. Family history negative. In 1912 a scaly patch appeared on right side of neck. This was treated with some kind of plaster. In 1917, a new lesion appeared on site of former growth and later broke down and ulcerated. At time of his visit there was a deep ulcer, with hard, indurated edges that rolled inward (Fig. 4A, left). Diagnosis was in question but since there was no metastasis growth was probably a basal cell carcinoma. Six double erythema doses of X-rays through a cone one and one-half inches in diameter caused lesion to heal (Fig. 4B, right).

taken to mean that I am opposed to the well recognized methods. While it is my privilege to discuss X-ray therapy in the treatment of cancer of the skin, I want it distinctly understood that in the conduct of our work every form of treatment is used that will, in our judgment, give the patient the best possible chance to make a complete recovery.

When any remedy is given precedence over other remedies in the treatment of skin cancer it should be because it possesses distinct advantages over those remedies. The advantages of X-ray methods will be stressed under the following seven heads:

- (1) The value of X-ray treatment as compared with other methods of treatment;
- (2) The possible mortality hazard in using X-rays in the treatment of skin cancer;
- (3) The degree of pain and discomfort resulting from X-ray treatment;

(4) The length of time usually required for a cure;

(5) The cosmetic results following X-ray treatment;

(6) The extent to which metastases may be prevented and controlled;

(7) The possibility of recurrence following X-ray treatment for skin cancer.

In speaking on these seven points I mean to be perfectly frank in my statements, and I hope to show evidence that will support my arguments in every detail.

(1) X-rays offer a prompt and reliable means of removing practically every type of pre-cancerous condition, without leaving an unsightly scar.

In dealing with well organized malignant growths of the skin X-ray methods will compare favorably with all other methods of treatment. Lesions that have been considered inoperable and, therefore, incurable by surgical methods may sometimes be



Fig. 5. Farmer, age 78. Was first seen September 26, 1922. Family history: Sister died from cancer of breast at age of 70. Personal history: About January 1, 1921, a shallow ulcer developed beneath a scaly patch on right side of neck (Fig. 5A, left). Growth was rapid and metastasis to submaxillary glands was evident. Clinically, growth was a squamous cell carcinoma. Six double erythema doses of X-rays caused lesion to heal (Fig. 5B, right). The glandular structures were treated with higher voltage radiation, with marked improvement. In 1924 he moved to Georgia and we lost track of him.

cured by X-ray treatment, but these conditions are always in doubt, because there is a limit beyond which it is impossible to go with any remedy, however good it may be. Incurable growths may often be inhibited by X-ray treatment, the patient's condition benefited, and his life prolonged.

(2) The possible mortality hazard in the X-ray treatment of skin cancer should hardly be considered seriously. A fatal result from such treatment is probably unknown.

It is always possible, of course, to overexpose the tissues and in this way produce a necrosis that may be troublesome, but in the hands of competent physicians there is little danger of such an accident. Every possible protection should be given the patient in the way of filtration, the measurement of voltage, amperage and target skin distance, and the time of exposure. At this point I cannot refrain from mentioning the fact that in every department of medicine

and surgery, no matter how well trained the physician may be, accidents sometimes happen, and we cannot expect the radiologist to be an exception.

(3) Pain and direct suffering as a result of X-ray treatment of skin cancer is a negative factor. Pain that has existed before treatment is often relieved. The resulting dermatitis in some cases may occasion some discomfort for a time, but this condition is only temporary and disappears as the lesion heals.

(4) The length of time required for a cure is probably the most objectionable feature connected with X-ray therapy. Whether the multiple or the single massive dose method is used, some time is required for the lesion to disintegrate and heal. This delay is not always an objectionable feature, since the patient may go about his regular duties with little or no inconveni-





Fig. 6. Farmer, age 72. Was first seen May 16, 1922. Family history: Uncle and brother suffered from cancer. Personal history: Some months before his first visit a fever blister appeared on left side of lower lip. From this, an ulcer with hard, thick base grew to about three-quarters inch in diameter (Fig. 6A, left). Clinical diagnosis was probably squamous cell carcinoma without metastases. Six double erythema doses of X-rays, through a cone one inch in diameter, removed every trace of growth (Fig. 6B, right). There had been no recurrence January 1, 1926.

ence. In some cases surgery might offer a shorter convalescence.

(5) The amount of disfigurement that follows X-ray treatment of skin cancer is a factor that should be carefully considered, especially when the lesion is located on the exposed parts. In few instances has there been noticeable evidence of telangiectasis. In our experience careful filtration has served to markedly decrease the occurrence of this undesirable after-effect. When a slight telangiectasia replaces a dangerous malignant tumor, its presence seems more or less justifiable.

With few exceptions X-ray therapy has produced a very satisfactory cosmetic result which will compare favorably with that of any other method of treatment.

We are fully aware of the fact that, in well selected cases, surgery has accomplished wonderful results in primary operations, and as a reconstructive measure in

secondary operations it is of inestimable value, but none of these operations which we have seen produces the splendid cosmetic results that follow X-ray treatment of cancer of the lower lip, photographic illustrations of which accompany this paper.

(6) Prevention and control of metastases may be possible when the treatment is applied to the glands to be protected at an early date. In squamous-cell carcinoma of the lower lip, metastases to the sublingual and submaxillary glands and the glands of the neck will eventually occur unless inhibited or prevented by early destruction of the primary growth. Properly applied X-ray treatment has, on several occasions, we believe, prevented such secondary lesions. Even after metastasis has become a fact, vigorous X-ray treatment may inhibit further growth, and in some cases apparently cause a complete cessation of malignant activity for a long period of time, although

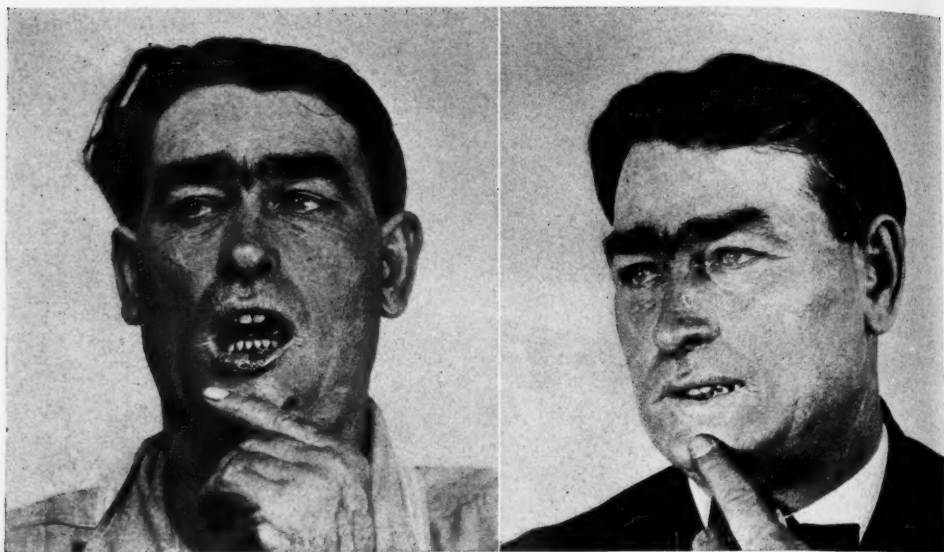


Fig. 7. Truck driver, age 32. Was first seen August 29, 1922. Family history was negative. The lower lip had been mashed several times. In 1920 a warty growth appeared, continuing to grow until half of lip was involved. Base was indurated, edges everted, and center ulcerated (Fig. 7A, left), on right side of face—this also had been treated with a plaster. At time of his visit entire upper lip Clinical diagnosis was squamous cell carcinoma. Seven double erythema doses of X-rays through a cone one inch in diameter removed every trace of lesion (Fig. 7B, right). There had been no evidence of recurrence January 1, 1926.

proven cures have not been obtained in these cases.

(7) The possibility of recurrence at the site of the former lesion is no greater after X-ray treatment than after any other method of treatment. Recurrences, in our experience, have been rare where thorough treatment has been given.

There will probably be little or no criticism among radiologists of the correctness of the above statements, but I will meet with decided opposition when I attempt to defend a technic by which such results are obtained.

There is still at this time a decided difference of opinion as to just what the proper dose of X-rays should be, when applied to the treatment of skin cancer. Until we have learned a great deal more about the biological effects of X-rays on normal and malignant tissues, their administration will continue to be empirical.

In the beginning most cases of skin cancer were treated with soft unfiltered rays. There were many cures and quite a few recurrences, because the effect of the low voltage soft ray reaction was too superficial. High voltage, filtration and longer exposures have greatly improved X-ray therapy in the treatment of skin cancer, and, as a result, cures are the rule and recurrences less frequent.

As with other therapeutic remedies, the maximum dose of X-rays for the destruction of a lesion should be given when it can be administered without doing irreparable damage to the surrounding tissues. All malignant lesions do not respond to X-ray treatment in exactly the same manner, and there is no index on the surface to indicate the X-ray dose required to produce a satisfactory result. Therefore, successful therapy resolves itself into a personal equation

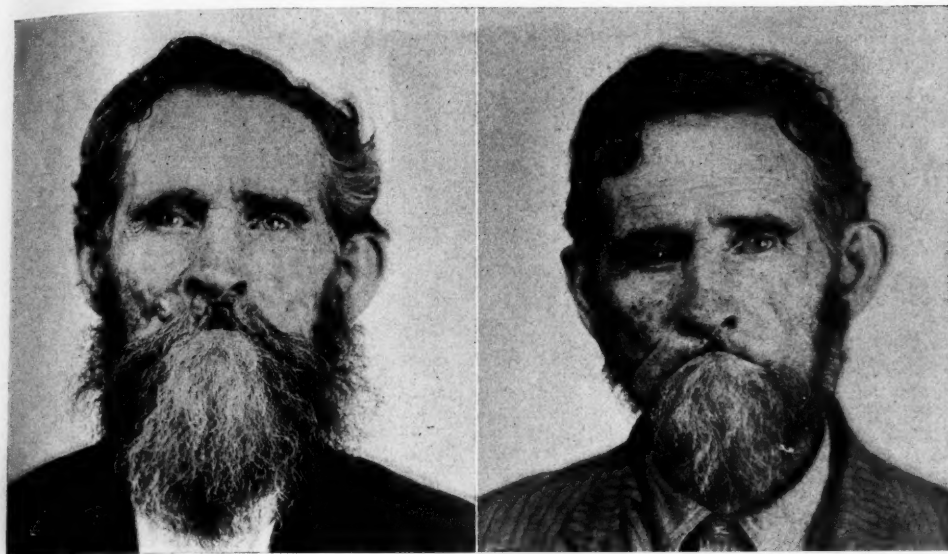


Fig. 8. Farmer, age 63. Was first seen April 10, 1922. Family history: Brother had carcinoma of face. Personal history: Had been treated seven years before present examination with a plaster, without success. Growth continued to enlarge till it destroyed half of upper lip. A second lesion appeared on right side of face—this also had been treated with a plaster. At time of his visit entire upper lip was ulcerated and distinctly indurated. The newgrowth on right side of face was growing rapidly (Fig. 8A, left). Clinically, these were thought to be basal cell carcinomas. Six double erythema doses to lip and to growth on side of face removed the lesions (Fig. 8B, right). There had been no evidence of recurrence May 22, 1924.

depending upon the knowledge and skill of the radiologist.

A careful history of each case is taken and several photographs are made before treatment is begun. A section is seldom removed for histological study. From a scientific standpoint, this practice is the weakest link in the chain of our work. In questionable cases we insist on having a biopsy made, but where the condition is clearly cancerous, a section is not considered essential to a cure, while the removal of tissue favors metastases and increases the liability of a scar—always objectionable when the lesion is located on the exposed parts.

The factors used are: 5-inch spark gap, 5 milliamperes, 5 to 10 minutes' exposure at a 10-inch target skin distance, and a filter of  $\frac{1}{2}$  millimeter of aluminum. A 5-minute exposure, using the factors as stated, will produce a pronounced erythema on the aver-

age skin over an area of an inch and a half diameter. Larger areas require lesser exposure for the same effect.

The technic employed is what we have several times described as a fractional or divided dose method, but it should more properly be termed a multiple dose method, since one or two erythema doses are used at the time of each treatment. The number of treatments has varied according to the size, age and nature of the lesion, and may be two, four, six or more as our judgment dictates. Lesions that are distinctly cancerous are given two erythema doses at each treatment and the exposures are repeated every other day.

When the lesion is indurated with or without ulceration, even though the growth be small, I believe it is wise to push the treatment to the point of an active dermatitis. A reasonable degree of over-exposure

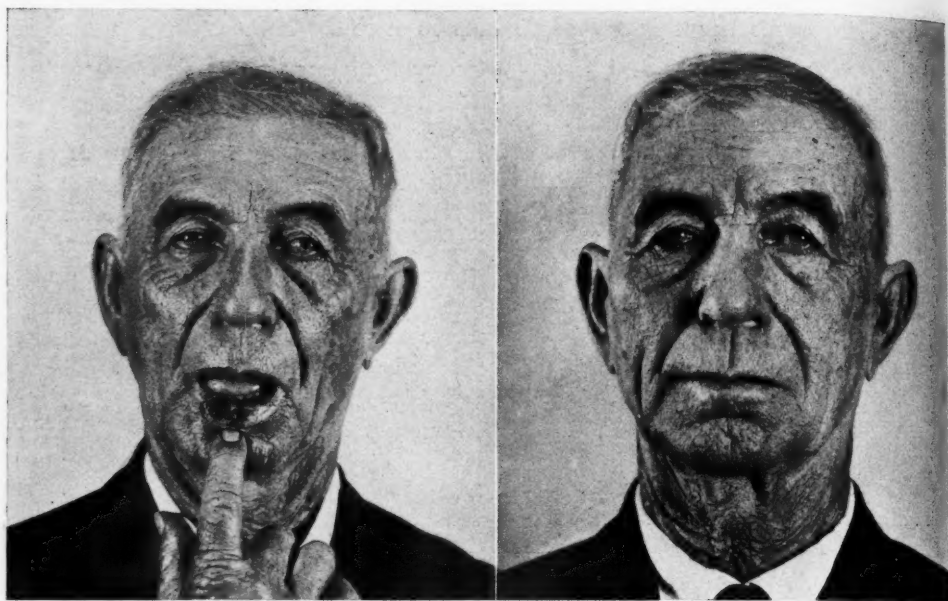


Fig. 9. Farmer, age 65. Was first seen May 29, 1923. Family history was negative. Lower lip was injured in 1922. This was followed by formation of a hard lump and later by an ulcer. At time treatment was started, lesion covered half of lower lip (Fig. 9A, left). Clinical diagnosis was squamous cell carcinoma. Six double erythema doses of X-rays through a cone one inch in diameter removed every evidence of lesion (Fig. 9B, right). There had been no evidence of recurrence or metastases January 10, 1926.

will do no harm, while recurrence is likely if insufficient treatment be given.

For the treatment and prevention of metastases in the submaxillary glands and the glands along the lymphatic chain of the neck, both superficial and deep, we are using the following factors: a 9-inch spark gap and 5 milliamperes for 30 minutes at a 12-inch target skin distance, with a filter consisting of  $\frac{1}{2}$  millimeter of copper, 1 millimeter of aluminum and 4 layers of leather. The effect of this exposure on the skin is less than an erythema dose, and may be repeated once in ten days in cases where metastases have developed and in three weeks when it is used for its prophylactic effect. The current is stabilized and two milliamperemeters in series are used for checking the current flow. The time is guarded by a good clock that rings an alarm at the termination of each exposure. A de-

tailed record is made during each treatment. The areas exposed are indicated on a figure on a chart and a complete summary is kept of the exposures, with the factors used.

When a sufficient amount of treatment has been given, the patient is allowed to go home for a period of a month, if he lives near us, or he is asked to report by mail if he lives at some distant point. In this way all cases are followed as closely as possible, and, when necessary, are required to return for a second series of treatments. In the early cases further treatment is seldom required, but in large cancerous growths a second series may be necessary to destroy the lesion.

When the patient is finally dismissed ten form postal cards bearing his record number are given to him, with instructions to carefully fill in a card at the end of every six months and mail it in to the office to be





Fig. 10. Farmer, age 61. Was first seen October 11, 1920. Family history: Mother had carcinoma of mouth. Personal history: Patient has had leukoplakia since 1904. Several months before examination a hard nodule appeared on right side of lower lip. Growth was rapid. At time treatment was begun, lesion was about one inch in diameter, indurated and ulcerated in center (Fig. 10A, left). A distinct tumor could be felt beneath right jaw. Clinical diagnosis was squamous cell carcinoma, with metastases. Six double erythema doses of X-rays healed lesion on lip. Deep X-ray treatment over tumor beneath jaw reduced the size 75 per cent (Fig. 10B, right). There had been no recurrence January 1, 1924.

filed in his record. In this way we have been able to keep up with the progress of most of our cases for a period of five years, and often much longer. When patients do not send in their report cards regularly, it is our custom to write them a Christmas letter calling their attention to the fact. With this letter we enclose a very comprehensive report blank and a stamped return envelope, and insist on a report by return mail. We are seldom disappointed. In case the patient has died, some member of the family sends us a card or answers our letter of inquiry.

It may be of interest to mention briefly some of the details of technic that have helped to bring good results in our treatment of skin cancer. The technician who has charge of the administration of X-ray therapy occupies a comfortable seat in a booth where the switches on the control

stand are in easy reach and where the meters, clock and the patient are clearly visible. An ample supply of stationery in the form of record blanks is kept in a pocket on the right hand side of the booth.

Three filters are used for the different classes of work; in identifying these filters, I am indebted to Dr. Pfahler for his ideas. Different colors of bright ribbon are attached to the filters, which are in plain view of the technician when the filters are in place. Before a case is treated, a prescription for the treatment is made out for the technician's guidance. All of the factors to be used in the treatment are clearly indicated on the prescription. Before the technician starts the machine she reads the prescription carefully, notes the size of the filter in the prescription, the color of the ribbon marker attached to the filter, then writes after the filter record the color of the

ribbon which indicates the size of the filter in place at that time. If the color of the ribbon does not agree with the filter required for that exposure, the mistake is discovered in time to prevent trouble.

In the earlier days sheet lead or lead foil was used for protection of the surrounding tissues; later, leaded rubber was considered an improvement. For the past five years I have used exclusively heavy metal cones, connected with the tube carrier, and have found them a very decided improvement over all other methods with which I am acquainted. These cones are made of heavy brass and are in four sizes, the openings of which are three-quarters of an inch, an inch and a half, two inches, and two and five-eighths inches in diameter, respectively. These cones do away with the uncomfortable lead foil and lead rubber covering of the early period of superficial X-ray therapy. In the treatment of most superficial lesions the cones may be brought firmly down on the tissues around the area to be exposed. Besides being a convenience to use and a comfort to the patient, the cone serves further purposes in helping to hold the patient still during the exposure and in

keeping the area to be treated directly under the central rays from the tube.

The cases used to illustrate this article are fair examples of the early types of skin cancer, and the results obtained from X-ray treatment may be duplicated easily in the treatment of all like cases.

While I am supporting the therapeutic value of the X-ray in comparison with other methods, I do not want to leave the impression that I am producing 100 per cent of cures. I cannot correctly estimate the number of cures, because it is impossible to get accurate reports on all cases, since they are scattered over a very large territory. Most early lesions respond promptly to properly directed X-ray treatment: the results obtained in advanced lesions depend on many factors. In many cases of this latter type surgery in the form of the knife, actual cautery or electric coagulation will produce better results than X-ray treatment. The combined use of X-rays and other methods is sometimes indicated. To succeed in the treatment of skin cancer, all cases should be seen early and that treatment selected which, in the opinion of the operator, will give the patient the best possible chance to make a complete recovery.

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## THE X-RAYS AND RADIUM IN THE FIGHT AGAINST CANCER<sup>1</sup>

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IN the campaign against cancer, all possible resources must be utilized. Until the exact cause of cancer has been determined and a specific cure has been found, our aims in this fight must be—

(1) To remove, in the individual patients, the unhealthy conditions which we have learned precede cancer, and thus possibly prevent cancer;

(2) To make an early diagnosis, while the disease is still local;

(3) To treat the disease immediately, radically, and thoroughly.

The early diagnosis of cancer, so far as our present knowledge goes, is the most important factor in the treatment of the disease. It is only rarely that any method of treatment can be successful when the disease is far advanced and has spread to distant parts. With the medical knowledge now available, cancer should be recognized while it is still a local disease, with the exception of some of the cancers of the viscera. If the disease is recognized while it is still localized and if it is completely removed, a cure may be expected.

Early diagnosis depends upon two factors:

1. The public must learn to know the symptoms which suggest cancer. This can be accomplished by public lectures, as recommended by the American Society for the Control of Cancer, but even more effectively by the physician in his daily work as he comes in contact with the patients and their families.

2. The physician must be thorough in

his examinations and utilize every method of differentiation that is available. Periodic health examinations, if thoroughly done, will help in the early recognition of cancer. If all symptoms which suggest cancer are relieved, some cancers will be prevented and many cured in the early stages. It is self-evident that to accomplish these ideal results, every physician must be a keen student and thoroughly conscientious in his work.

The X-rays are an important factor in the early diagnosis of cancer of the esophagus, the stomach, the colon, and the rectum. The X-rays are also most important in the diagnosis of tumors involving the bones, the chest, the liver, the pancreas, and the brain and spinal cord.

### RADIATION THERAPY

The X-rays and radium are also of definite value in the treatment of cancer. The earlier, the more thoroughly, and the more skillfully the radiation is applied, the better will be the results. It is just as important with radiation as with surgery, to make an early and accurate diagnosis, to determine the total extent of the disease and then to surround the disease with the radiation sufficient to overcome it. So far as our present knowledge goes, the X-rays and radium have an effect only on the tissues which are actually penetrated by the rays. Therefore, so far as possible, all of the cancer tissue should be equally and thoroughly irradiated.

The X-rays and radium exert a somewhat selective effect on proliferating tissue cells and especially on tumor cells. Kroenig and Friedrich (1) have shown by carefully con-

<sup>1</sup>Presented before the Joint Meeting of the Radiological Society of North America, the State Medical Society of Wisconsin, the Medical Society of Milwaukee County and the Milwaukee County Radiological Society, Dec. 1, 1926, at Milwaukee, Wis.

ducted experiments that in like quantity the gamma rays from radium have about three times the biological effect of the most penetrating X-rays that are in practical use. This effect, of course, demands that a like quantity of radiation from the radium shall reach the diseased tissue. In the treatment of deep-seated disease, however, it is commonly easier to deliver three times as much radiation from the X-rays as from radium. When the gamma rays from radium can be used sufficiently to reach all parts of the disease, the results will be better.

Ewing (2) says: "In general, the tumors derived from embryonal cells and retaining embryonal characters, even when growing rapidly, are, as a rule, particularly susceptible to radiation. Very cellular, rapidly growing tumors of any type, even when derived from adult cells, are often very susceptible to radiation, although the rapid extension of such tumors renders the prognosis poor."

Strictly speaking, cancer is a microscopical disease; its extensions are microscopical and the curative changes can be studied microscopically. Yet from a practical clinical standpoint, we must deal with cancer to-day as a disease that can be seen and felt.

Knowing from scientific records the manner of extension of the disease, we aim to surround it by total excision in its earliest stages, or to surround it by destructive radiation. Radiation can be more extensive than surgical excision, but, generally speaking, the combination of radiation and excision will accomplish the best results.

Pre-operative radiation in an operable case should be of advantage to devitalize the cancer cells and thus make them less likely to grow if transplanted during an operation. This devitalizing effect has been shown experimentally by Nogier, Jaubert de Beaujeu, and Contamin (3), who found that the half of the tissue from an adenocarcinoma which had been irradiated and then inocu-

lated into fifteen mice did not take, while the other half of the tumor which had not been irradiated when inoculated into controls took in fourteen out of fifteen cases. Pre-operative radiation also has a favorable effect upon the surrounding tissue, as has been shown in the experiments by Murphy (4) and his colleagues at the Rockefeller Institute, which have demonstrated that irradiated tissue resists the inoculation of cancer tissue.

In operable cases in which pre-operative radiation is given, the operation should be done as soon as the constitutional effects of the radiation have passed. The operation can be done usually in from two days to two weeks after the beginning of the radiation, depending upon the location of the disease and the amount of radiation that is needed.

*Pre-operative radiation* can be used also in cases in an inoperable stage, in preparation for operation. In such cases the aim is to change the outlying disease to fibrous tissue, and then, after two or three months, remove the remaining palpable tumor, which will commonly be found still to contain some cancer cells.

*Post-operative radiation* is now almost universally accepted as an advantage. It is based upon the theory that we are treating remnants of the cancer which cannot be seen nor felt, and, therefore, have not been removed. The common recurrence of the disease following operation, excepting in the very early cases, shows that it is commonly impossible to remove the cancer cells totally. We have all seen the permanent disappearance of palpable and visible recurrent cancer under the influence of radiation. We have a right, therefore, to assume that if the disease will disappear when it has grown long enough to be seen and felt, similar tissue would disappear in the same manner if treated while it is of microscopical size only. The value of post-operative treatment has also been shown by statistical

studies, and will be referred to in connection with breast cancer.

Post-operative radiation should be given as soon after the operation as is practical, which will usually be within from one to two weeks. Fractional doses seem to be preferable to massive doses, but the fractional doses should be carefully measured and their cumulative value estimated. We should avoid atrophy, fibrosis, and telangiectasis.

From a practical standpoint in radiotherapy we must consider cancer as it affects different parts of the body. In every instance, the plan of treatment must be adapted to the individual case. Toward this end it would be an advantage if the family physician, the surgeon and the radiologist could confer and then decide upon the best treatment to be used upon each patient.

#### CANCER OF THE SKIN

If treated while the cancer involves only the skin, practically all cases should recover, either with radiation alone, or with radiation following electrocoagulation. Cancers about the eyelids, and in any location where the greatest possible conservation of tissue is necessary, are best treated by radium. When a soft scar is not objection-

able, as in most parts of the body, it is my practice to destroy the lesion at once by means of electrocoagulation, curet the base, and then follow by radiation. This gives the quickest and entirely satisfactory results.

#### CANCER OF THE BREAST

When cancer of the breast can be diagnosed while it is strictly localized and therefore can be completely removed, I believe that immediate excision is the proper treatment. Unfortunately, only a small percentage of cases are operated upon in this early stage. In a recent report from London (Leeds), by Dr. Janet Lane-Clayton, only 17 per cent were in this early operable stage, or only about one in six. Therefore, in about five out of six cases we must realize that the disease has spread, and in these cases, radiation and operation can be combined to advantage. The advantages of combining radiation have been shown, especially by the statistics of Döderlein (5), Wintz (6), Schmitz (7), and by an analysis of over 800 breast cases studied by Widmann and myself.

It will be seen from the tabulation below that if patients are thoroughly and skillfully operated upon while the disease is *still strict-*

#### COMPARATIVE VALUES OF OTHER CLINICS AND METHODS (OPERABLE CASES)

		Alive 3 years		Alive 5 years	
		No glands,	With glands,	No glands,	With glands,
		per cent	per cent	per cent	per cent
Greenough.....	Surgery .....	47	19	....	....
Kroenig.....	Surgery .....	....	....	100	39
Bloodgood.....	Surgery .....	....	....	70	20
Lee.....	Surgery .....	....	....	....	15
Finsterer.....	Surgery .....	....	....	....	4.3
Döderlein.....	Surgery .....	....	....	46	5
Döderlein.....	Surgery and radiation, not completed.....	....	....	48	20
Döderlein.....	Surgery and radiation, totally completed.....	....	....	80	36
Wintz.....	Surgery and radiation, both groups, 77%.....	....	....	48	....
Schmitz.....	Surgery and radiation .....	....	....	64	42
Pfahler and Widmann.....	Surgery and radiation .....	....	....	68	46



ly localized, surgeons have obtained from 47 to 100 per cent cures; but when the disease has spread to the *glands of the axilla* various authors report that only from 4.3 to 39 per cent recover from operation alone, the general average being about 20 per cent, or one in five.

If, however, the operation is combined with radiation, the five-year cures are increased, as reported by various authors, to from 36 to 46 per cent, or just about double the number from operation alone. The patients with *inoperable primary* or with *recurrent cancers* of the breast can have their lives prolonged, made more comfortable, and some can be cured.

#### CANCER OF THE LIP

If every sore or crust that forms on the lip is treated immediately and thoroughly, cancer of the lip can generally be prevented. If cancer is treated at the beginning by thorough electrocoagulation and associated thorough radiation over the local area and over the adjacent lymphatics (9, 10), we have found that it can be cured in about 90 per cent of the cases, providing it is treated before there are palpable lymph nodes. Schreiner (11) has found that even patients having an involvement of the lymphatics, but which from the standpoint of surgery are considered in an inoperable stage, can be healed in at least 34 per cent of the cases.

In the Radium Home, in Stockholm, Sweden, which is under the direction of Forssell, primary cancer of the lip has been cured in 77 per cent of the 133 cases treated (12).

#### CANCER OF THE TONGUE AND MOUTH

These cancers of the tongue and mouth are practically all of the squamous cell type. They spread rapidly to the surrounding tissue and within six weeks often become inoperable or even incurable. Therefore, any

sore about the tongue or mouth that does not begin to heal within two weeks should be regarded as malignant until proven otherwise, and should be treated accordingly.

The chief etiological factors are chronic irritation, as from tobacco, sharp edged teeth, badly fitting plates, repeated applications of chemicals, etc., and syphilis (positive Wassermann in 14 to 40 per cent in different reported series). Therefore, when a positive Wassermann test is found, the diagnosis of cancer is not excluded, and, if antisyphilitic treatment gives no definite improvement within two weeks, cancer is likely present. Cancer of the tongue and floor of the mouth, when treated thoroughly and skillfully by radiation, at times associated with electrocoagulation, should be cured in at least 25 per cent of the cases. This applies to the general average as they come, and my recent observations lead me to expect more. If, however, all lesions of the tongue and mouth are treated thoroughly and skillfully at the beginning, cancer should be prevented or cured in nearly all cases.

Régaud (13), in the Radium Institute of Paris, records 24 per cent of cures of cancer of the tongue from one to five years, by means of radiation, counting all the cases treated, and *46 per cent of the cases that could be classed as operable*. Forssell (12), at the Radium Home in Stockholm, obtained *38 per cent of cures in the general cases of cancer of the tongue*.

*Cancers of the gums, cheeks, tonsils, and pharynx* seem to me to be more responsive to radiation treatment than those which involve the tongue and floor of the mouth. Radium, if used in sufficient quantity, is much superior to the X-rays in the treatment of intra-oral cancer.

#### CANCER OF THE UTERUS

Radiation has been found especially useful in the treatment of cancer of the cervix uteri. Various authors report from 40 to

80 per cent five-year cures in the cases in which the disease is still confined to the uterus and classed as operable, and 25 to 40 per cent when the clearly operable and borderline cases are classed together. The earlier a case is treated and the more thoroughly and skillfully the radiation is applied the better will be the results.

*Cures in the operable and borderline cases of carcinoma of the cervix.* Hayman (14) found five-year cures in this more select class of cases, treated in the Radium Home in Stockholm, to be 40 per cent, while the general report (12) from this home shows 32 per cent to be free from symptoms during a period of from one to five years when all the cases are considered. Mattick (15) reports 80 per cent cures in Group I, 40.7 per cent in Group II, and 10.8 per cent of all cases (368) as they came, treated before 1924.

Healy (16) reports from the service of Dr. Bailey, in cases treated from 1918 to 1921, inclusive, and from his own service in cases from 1922 to 1924, inclusive (Tables I and II).

Healy concludes:

"1. From a study of our own statistics it would seem reasonable to assume that a diagnosis of cancer of the uterine cervix is an indication for radium therapy."

"2. Operation is justifiable only when serious contra-indications to radiation therapy are present."

In estimating the value of radiation treatment of cancer of the cervix it must be remembered that only about 12 to 35 per cent of all the cases can be considered for operation, because the others are too far advanced. Therefore, operative statistics deal only with a small proportion of selected cases, while radiation is used in all types of cases.

The total or average value of radiation when all types of cases are considered is shown in Table III, prepared by Martin and Rogers (16).

The advantage of early radiation treatment (48 to 80 per cent cures), compared with late treatment (6 to 0.8 per cent cures), is best shown by the statistics prepared by Von Seuffert, from the Döderlein Clinic (Tables IV and V, pages 220 and 221).

TABLE I

CASES TREATED BY RADIUM THERAPY  
(1918 to 1921, inclusive, service of Dr. Harold Bailey<sup>2</sup>)

	Total	Alive Jan. 1, 1925	Alive per cent
Cervix			
Early, 9% .....	35	14	40
Borderline, 14% .....	52	14	27
Advanced, 77% .....	288	25	8.6
Total cervix .....	375	53	14
Recurrent cervix .....	139	28	20
Post-operative irradiation....	25	16	64

TABLE II

CASES TREATED BY COMBINED RADIUM AND ROENTGEN THERAPY  
(1922 to 1924, inclusive, service of Dr. William P. Healy)

	Total	Alive	Alive per cent
Cervix			
Early, 12% .....	44	41	93
Borderline, 16% .....	57	42	73.6
Advanced, 72% .....	252	113	44.8
Total cervix .....	353	196	61
Recurrent cervix .....	71	41	57.7
Post-operative irradiation....	5	5	100

TABLE III

PERCENTAGE OF FIVE-YEAR CURES FOR ALL CASES TREATED<sup>3</sup>

Clark and Keene.....	19.2
Von Seuffert .....	10.0
L. Seitz .....	20.9
Gustav C. J. Scholten.....	13.8
H. Döderlein .....	13.2
Robert B. Greenough.....	11.0
Henry Schmitz .....	14.5
H. V. James Heyman.....	20.29
C. Régaud .....	20.00
H. A. Kelly.....	20.00
Parache .....	19.75
Average .....	17.05

<sup>2</sup>Am. Jour. Roentgenol. and Rad. Ther., December, 1925, pp. 542-546.

<sup>3</sup>Martin and Rogers, Proceedings American Roentgen Ray Society, September, 1925.

TABLE IV  
CARCINOMA OF UTERUS

Von Seuffert, 1923 (p. 482, Cures of 5 Years or More, Döderlein's Clinic, Munich.

Group I Therapy	Total cases treated	Still operable Group I	5-year cures in Group I
Operation	265	42% - 110	51 - 46%
Radiation	500	15% - 77	37 - 48%
Completed radiation treatment	77	55% - 43	35 - 80%
Group II Therapy	Total cases treated in clinic	Borderline cases, Group II	5-year cures, Group II
Operation	265	22% - 57	3 - 5%
Radiation	500	19% - 90	18 - 20%
Completed radiation treatment	90	56% - 50	18 - 36%
Group III Therapy	Total cases treated in clinic	Positively inoperable cases, Group III	5-year cures in Group III
Operation	265	34% - 92	0 - 0%
Radiation	500	43% - 214	13 - 6%
Completed radiation treatment	214	57% - 121	13 - 11%
Group IV Therapy	Total cases treated in clinic	Hopeless cases, Group IV	5-year cures, Group IV
Operation	265	2% - 6	0 - 0%
Radiation	500	23% - 119	1 - 0.8%
Completed radiation treatment	119	17% - 20	1 - 5%

These statistics in Tables IV and V were prepared from cases studied in a general gynecological clinic. The same rules were applied in classifications for the radiation cases as for the operative cases. The group of cases making up the operation statistics were treated during the years from 1908 to 1912, while those used for the radiation statistics were treated from 1913 to 1916. The final classification shows the cures that

might have been expected if these last 500 had been operated upon, as compared with the actual cures obtained by radiation. Taking the operable and borderline cases together, when treated by operation 24 per cent could have been expected to be cured by operation in this group of cases, while 34 per cent were actually cured by radiation. These statistics show that, while of the patients who came early and carried through their treatment thoroughly 80 per cent were cured, only 14 per cent of the general average was cured, because most came late and many did not finish their treatment.

Time will not permit a review of cancer of all parts of the body, but we may conclude as we began: *With our present knowledge, our hope lies in the early diagnosis of cancer and thorough radical treatment from the beginning.*

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TABLE V  
CARCINOMA OF THE CERVIX  
(From Döderlein's Clinic, Munich)  
Von Sautfert 484, absolute values of operation or radiation in carcinoma of the uterus.

Therapy	Operable cases, Group I	Borderline cases, Group III	Groups I and II		Inoperable cases, Group III	Hopeless cases, Group IV	Total of All Cases		"Absolute" curative values
			Operability	"Relative" curative values			All groups	Well at least 5 years	
Time Period									
1908-1912	Total number treated Cured by operation	42%—110 51—46%	22%—57 3—5%	63%—167	of 167 cases 51+3=54, 32%	34%—92 0—0%	2%—6 0—0%	167+92+6=265	54+0+0=54 $\frac{265}{54} = 20\frac{5}{34}$
1913-1916	Operative value of cases treated during this period Of all cases in the clinic Cured by radiation	46%—35 15%—77 37—48%	5%—5 19%—90 18—20%	34%—167 of 167 37+18=55, 34%	0%—0 43%—214 13—6%	0%—0 22%—119 1—0.8%	167+214+119=500	55+13+1=69 $\frac{500}{69} = 14\frac{1}{69}$	$\frac{500}{40} = 8\frac{1}{40}$
	Total of cases completing radiation treatment Completed treatment, cured	55%—43 35—80%	56%—50 18—36%	55.5%—93	35+18=53, 58%	57%—121 13—11%	17%—20 1—0.8%	93+121+20=234	53+13+1=67 $\frac{234}{67} = 29\frac{1}{67}$

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## RADIO-ACTIVE SUBSTANCES: THEIR THERAPEUTIC USES AND APPLICATIONS

### THE RADIUM TREATMENT OF HYPERTHYROIDISM

By JOSEPH MUIR, M.D., NEW YORK CITY

THE pathologic condition which I am about to discuss is known in medical literature under a variety of names. In England it is called Graves' disease; in Germany and on the Continent largely, *morbus Basedowii* (the malady of Basedow); here the same combination of symptoms and clinical manifestations is known as toxic goiter, exophthalmic goiter, hyperthyroidism, and by several other designations which do not come to mind at the moment. To the layman and the student this inexactness in nomenclature is highly confusing, and even physicians who are familiar enough with the condition in the variety of aspects which it presents, are more or less puzzled to know just how to name it so as to make themselves perfectly understandable to all hearers. To my mind, however, the term "hyperthyroidism" is the most precise, as this makes mention of the basic factor in the production of the disease, and covers alike those manifestations where there is no bulging of the eyes despite over-activity of the thyroid gland, as well as those cases in which the exophthalmos is the most striking symptom. Inasmuch as radium treatment aims to abolish this over-activity, thus secondarily eliminating the results of perverted function, it seems logical to speak of the radium treatment of hyperthyroidism, which covers all the lesser variations dependent upon this primary cause.

It was apparently that enthusiastic pioneer in so many applications of radium, Robert Abbé of New York, who was the first to think of making use of the then new therapeutic agent, for the treatment of hyperthyroidism. Before this country boasted any periodicals devoted to radiologic topics, when, indeed, all the reputable medical jour-

nals looked decidedly askance at the "exploitation" of a new and somewhat doubtful therapy, he published in the *Archives of the Roentgen Ray*, a London scientific paper, the report of a case of "Exophthalmic Goiter Reduced by Radium." This report is a remarkable document in many respects, for not only does it seem to be a record of the first attempt made to control thyroid hypersecretion with irradiation, but it also details a method of application at that time both unknown and untried under similar conditions, namely, the implantation of the radio-active agent directly within the tissue it is desired to affect. Abbé had previously used this method upon a giant-cell sarcoma of the lower jaw, and was far-sighted enough to argue that a similar procedure might be equally effective in so widely dissimilar a condition as enlargement of the thyroid gland. The patient upon whom he essayed the experiment was in such an advanced stage of the disease that he was fully convinced "the most ardent advocate of surgery would have refused to operate," so that the use of radium was in this case, as in practically all others in those pioneer days, a last resort, when all other hope had failed.

Abbé's own description of his procedure is as follows: "Under cocaine anesthesia I made a small median incision in the neck, dissecting down to the isthmus of the thyroid, carefully avoiding large veins. The hypertrophied middle lobe was apparently one and a half inches thick. Into this I thrust a small, sharp bistoury, making a deep enough incision to bury a sterilized tube of radium at right angles to the skin an inch deep. It was held in place by sterile dressings and straps, the patient keeping her head fairly quiet for twenty-four

hours. The glass tube was one-eighth inch in diameter, and contained 10 centigrammes of Curie radium (300,000 activity). The tube was removed in twenty-four hours, and the wound closed with strapping. Nothing could be seen unusual in the healing of the wound or in the appearance of the tissues." There were no immediate results, but after about a month the enlargement of the thyroid rapidly diminished, and after four months the goiter was scarcely visible. All the typical symptoms of hyperthyroidism had disappeared, although some tachycardia was still present. The patient looked and felt entirely well, however, and from a bed-ridden invalid had become a healthy and useful young woman. In 1910 Dr. Abbé reported: "The patient has remained in perfect health ever since [a period of six years] and has no recurrence of goiter or symptoms." He added, however, that he had tried the same method in "more than a dozen cases of goiter with variable but sometimes strongly favorable results, amounting to a cure." In those cases where he had—to use his own words—"fallen down," he attributed it to insufficient dosage, due usually to irregular attendance on the part of the patient. This would indicate that in his later cases he used repeated dosage, but he gives no explanation of this, nor any reason why he came to consider the single adequate dose undesirable.

There appears to have been no haste on the part of others charged with the care of patients suffering from over-activity of the thyroid, to follow the trail thus early blazed by Abbé, for not until a full decade had passed do we find any serious consideration being given to radium application in the treatment of this condition, and not until after the close of the Great War did it come to be regularly regarded as a therapeutic possibility. In 1919 we find Dawson Turner, a Scotch practitioner, claiming to have treated "upwards of fifty cases with radium, and with one exception all of those pa-

tients derived more or less benefit." This "benefit" was, however, in his opinion, more to the patient's general well-being than to the thyroid gland itself, for he stated that this was little, if any, reduced in size, while exophthalmos was not noticeably diminished. He gave a dosage of from 200 to 400 milligram hours, properly screened, over each lobe of the thyroid and the isthmus, repeating the application if it seemed necessary, after a three months' interval. As compared with X-rays in the treatment of hyperthyroidism, he felt that radium had the following advantages: "(1) Absolutely constant emission of rays and therefore exact dosage possible. (2) Far greater penetration of its rays, so that the deeper parts of the gland are reached. (3) No noisy, exciting apparatus, so that the treatment can be applied at the bedside without in any way disturbing the patient. The words *cito, tuto, et jucunde* can fairly be applied to radium treatment of exophthalmic goiter."

During the past five years the literature regarding radium treatment of the over-active thyroid has become fairly abundant, although, even yet, those who advocate irradiation in this condition are more likely to pin their faith to X-ray exposure, using radium only when for some reason the application of the X-ray is impossible. There were, however, several enthusiasts who had found radium the ideal treatment, and these men, in spite of much opposition, and neglect of their unquestionable scientific attainment, persevered in using it, and in making known their results, even when they realized that most of what they had to say fell upon deaf or openly skeptical ears. The method regularly used was surface application; it is exceptional to find any reference to implantation, such as was originally employed by Abbé. In the report from the Manchester (England) and District Radium Institute, made by Arthur Burrows, as far back as 1917, he tells of the treating of

79 cases of exophthalmic goiter, of which "all except two cases were irradiated by applying plates of a strength of 2.5 milligrammes or millicuries to the square centimeter, to the surface of the enlarged gland. The size of the plates used is such that 45 to 76.5 milligrammes were applied at one time, screened by 1.5 millimeters of lead and fixed in position for twenty-four hours. The applications were made every six weeks." The two cases which were not handled under this régime had implantations of tubes directly within the gland, but this author gives no details as to dosage, time of exposure or method of insertion other than to say that one patient did not return for re-examination, "but in the other, considerable diminution in the size of the gland and improvement in the symptoms was noticed."

The methods which were popular in England were successfully employed on this side of the Atlantic by the late W. H. B. Aikins of Toronto. In 1918 he reported that 45 patients had received treatment at his hands, and of these 23 had been clinically cured—"that is, the tachycardia, tremor and restlessness have disappeared, and symptoms of excessive thyroid secretion have abated. In 17 cases there has been an improvement, but not a complete cessation of symptoms. Four cases have passed from observation. In only 19 patients did the thyroid gland itself decrease in size, as evidenced by neck measurement, while in six there was no diminution in the size of the gland, although the nervous symptoms were completely relieved. . . . The relief of the nervous symptoms made it possible to undertake the surgical removal of the goiter for cosmetic reasons later on if the patient wished it."

In a somewhat later communication, Aikins detailed an experience which, in all, covered twelve years, the number of cases treated having by this time reached one hundred. He stressed the importance of ac-

companying any kind of treatment with suitable dietary measures, and careful psychic management of the patients with plenty of rest and as complete freedom from excitement of any kind as possible. Though he had used tubes in some cases, he preferred flat applicators, these being four centimeters square and containing ten milligrams of radium element, occasionally varying these dimensions a trifle, or employing only five milligrams of radium to a plaque. The screenage was with two thin aluminum screens or a single brass one about 0.8 mm. thick, with the addition of a layer of felt. The first treatment usually occupied three hours, enough radium being applied to bring the total dosage administered in this period up to from 150 to 360 milligram hours. He regarded it as more prudent to give smaller dosage at intervals than to concentrate heavy dosage, "as the latter is much more apt to cause systemic disturbances."

The influence of Aikins' enthusiasm was considerable and far-reaching, for a year later (1921) we find his work and opinions being quoted in the Introductory Address given before the Second Congress of the Northern Association for Medical Radiology, at Copenhagen. The speaker was S. A. Heyerdahl, chief of the Roentgen-Radium Institute of Christiania, and his object in bringing forward the Canadian's work was to popularize the use of radium in the Scandinavian countries, where, according to his statement, the X-ray treatment of hyperthyroidism had been extensively practised but the use of radium was but little known, owing to its high price and great scarcity. In his own institution but 24 cases had been treated by this agent, eight of these being "inoperable struma malignum," or, as we should term it, "cancer of the thyroid," which cannot properly be classed as hyperthyroidism. In all his goiter cases there was substantial improvement, two being completely relieved of all evidences of hyperthy-

roidism, and remaining permanently well. Like most other writers of this period he notes that the exophthalmos was the manifestation upon which the radium therapy seemed to have the least influence, as there seems to have been a very general failure to appreciate the factors which induce the protrusion of the eyeball, or to understand how, when this has existed for a considerable time, no treatment applied to the thyroid gland, be it ever so effectual in reducing its activity and removing the evil influences which it exerts over the system, can in any way restore the normal conditions behind the orbit, and that failure to do so is no indication that radium is ineffectual in relieving the disturbances in the gland itself.

Nearer home, Aikins' influence was acknowledged by several Americans, chief among them being R. E. Loucks of Detroit, who has of late been one of the staunchest advocates of radium treatment in hyperthyroidism. "It is," he says, "portable, less exciting, more easily controlled, does not produce a sudden toxemia, and results are more promising than with X-ray. Supplement your radium treatment with rest, protein-free diet, ice-bag to thyroid gland and at times to precordia. Medicate for two weeks if necessary and use alkalies freely." For the treatment "use 100 mgm. (at least) in four tubes, each tube screened in 1 mm. brass and 1 mm. gum rubber. The screened tubes are placed on a gauze pad 2 cm. in thickness to get distance and protect the skin. Two or three ports are exposed over the gland, depending on the size of the gland, size of the pad and the amount of radium used. The time of exposure varies from eight to ten hours over each port."

Loucks has been at more pains than most other investigators of this subject to check up the results of radium treatment by "metabolic deductions," using the same measurements and methods that are applied to surgical patients both before and after treatment. He found this most useful, as the

basal metabolic rate obtained before the radium treatment was instituted, estimates the degree of thyroid activity and also furnishes conclusive evidence of toxic control after it has been administered. Of 180 cases treated, more than 90 per cent were markedly improved, this improvement being manifested usually as early as ten days after the initial radiation. "Within four weeks the nervous tremor has commenced to subside, the appetite has improved, and the heart slowed down twenty or thirty beats. After two months all the symptoms are much better and most individuals gain a few pounds in weight. The improvement is gradual, as shown by the cases reported when the metabolic rate has been taken every three months after treatment. Some cases are free from all symptoms after six months, while others with large adenomata of long standing and with extensive myocardial change, take twelve to eighteen months to show a normal metabolic rate with a normal heart action. The enlarged gland gradually decreases in size in direct relation to the amount of cystic formation present. All hypertrophy or hyperplasia is reduced to normal, while the cystic type is reduced about one-half in size. The exophthalmos in many cases has been controlled after three years. However, all do not respond so favorably. . . . Metabolic readings have been made over a period of two and a half years and all have remained normal."

Another worker who has proceeded along these same lines is Frank M. Hagans, of Illinois, who remarks that "while the metabolism test may mean little to the surgeon I regard it as quite essential to the radiologist, as it serves as one of the many guides to a lessening in the degree of thyroid toxicosis that is gradually and continually taking place over the whole period of treatment—usually three months. The metabolic rate at this time should be within the radius of normal (no more than 15 plus or no less



than 15 minus). The same is true of the blood picture. A hemoglobin, differential red and white blood count, is made as a routine, at six different times during the treatment period of three months, and the change that takes place is most interesting."

This worker also used surface radiation alone, blocking out the field of application into four squares, one over each lobe of the thyroid, one over the isthmus and the fourth over the thymus gland. Each of these areas was treated with a tube of silver having a 0.5 mm. wall and containing 100 milligrams of radium element. Further filtration consisted of 1.0 mm. brass with two or three millimeters of rubber, the whole mounted on a block of wood about an inch thick. This apparatus was held in place by means of adhesive tape for a period of four hours. Repeated dosage is used, apparently every other day, until 1,500, 2,000, or even 3,000 milligram hours has been given.

Repeated fractional dosage, relying upon surface applications only, seems to have been the rule in the treatment of hyperthyroidism by radium, for it is exceptional to find any variation from this general principle of therapy. From Wallace I. Terry, of San Francisco, however, we received the suggestion more than six years ago that buried radium emanation would prove more efficient, and that by its use some of the chief stumbling-blocks in the way of successful radium treatment of the thyroid could be removed. In his Chairman's Address made to the Section on Surgery at the Seventy-third Annual Session of the American Medical Association, in 1922, Terry repeated this recommendation, and seems to have been the first surgeon to go on record as favoring the implantation of bare tubes in the hypertrophied thyroid gland. In this address he incorporated a histologic examination of a gland surgically removed some time after radium exposure reported by Dr. Edwin I. Bartlett, which may be quoted verbatim: "There is a small area 2 mm.

across, pearly white, in the center of which can be seen an emanation tube. Microscopically, the area shows for the most part fibrin, with here and there some shadows of old alveoli. Beyond this is a narrow zone of atrophic or degenerating thyroid and increase of connective tissue. Beyond this is compact thyroid tissue with undifferentiated cells, barely formed alveoli, or completely formed alveoli. The alveoli are lined by cuboidal or low columnar epithelium and contain little or no colloid. Many show desquamated cells. Beyond this, the picture is that seen in hyperplasia."

Terry's principal use of radium exposure seems to have been merely as a preparation for surgical removal, for of the 33 cases upon which he reported, 14 had resections of the thyroid after intervals varying from 32 to 114 days from the radium treatment. From six to ten millicuries contained in about six bare tubes was the usual dosage, these being introduced into the gland under local anesthesia, the instrument employed being a small caliber hollow needle through which the tube is pushed by a plunger to a depth of at least half a centimeter.

The method reported by Stevens<sup>1</sup> in this journal at the beginning of last year is probably fairly typical of the way radium is at present administered to patients suffering from over-activity of the thyroid gland in the majority of clinics. His procedure consists in using tubes or needles of ten milligrams in sufficient numbers to cover the tumor. They are applied in the form of a pack, filtered by the needle wall plus one millimeter of brass at a distance of two centimeters, a space of one centimeter's width being left between tubes. The exposure is never more than sixteen hours, and is governed by the needs of each patient. He usually combines radium with X-ray, and prefers to use X-ray on all ambulatory patients.

A consideration of the various methods

<sup>1</sup>January, 1926, p. 7.

which have been briefly examined leaves us with the impression that in the hands of most radium therapists the treatment of hyperthyroidism is a rather hit-or-miss performance, and the results on the whole have been far better than those who achieved them had any right to expect. But few studies of the effects of radium upon thyroid tissue have been made, but those few indicate very plainly that unless the treatment is applied with skill and intelligence it is likely to do more harm than good. Several years ago Bower and Clark made an experimental study upon the thyroids of normal dogs, using steel needles containing 12.5 milligrams of radium element, in exposures varying from two to twelve and a half hours. They found that "the primary changes induced by radium in the thyroid are hemorrhage and necrosis. Organization and healing are evident in the third week and complete about the twelfth. The normal thyroid is distinctly resistant to the action of radium; it is not a good tissue for the study of the finer histologic changes produced by radium; the nuclear degenerative changes characteristic of radiated malignant tissue are never seen. No toxic symptoms of any sort were observed. The apparent resistance of thyroid tissue to radiation would make it appear that implantation would be superior to surface applications, and that relatively large dosage must be employed to assure any extensive effect upon the gland."

In normal dogs the small amount of necrosis induced by the partially filtered radium distributed through the thyroid was not sufficient to give rise to toxic effects, but in a human subject suffering from hyperthyroidism this necrosis, and the additional strain it is sure to produce upon an already heavily handicapped organism, is a matter very seriously to be considered. It is obvious, therefore, that unscreened applicators should not be employed, but that implantation is superior to surface applications be-

cause of the natural resistance of thyroid tissue to any sort of radiation. In this dilemma we must, then, return to the method originally used so successfully by Abbé; we must implant a properly screened applicator. In almost a quarter of a century, however, the technic of radium application has made such strides that we can improve considerably upon Abbé's method, and in place of a single tube of high concentration which must be preceded by surgical opening of the gland in order to make a place for it, we can implant screened seeds which will enable us to distribute the dosage throughout the thyroid or confine it to one lobe if the indications warrant. We can calculate to a nicety exactly how much radiation the gland, or any selected part of it, will receive, and the moment the desired dosage has been administered we can withdraw the applicators and send the patient about her business.

Any form of radium therapy has the great advantage over surgery that in the greatly disturbed psychic state of all hyperthyroid patients, there is absence of excitement and shock, and when removable platinum seeds are used these advantages are even greater than under other conditions. When we are able to assure the patient that there will be no pain, no need of anesthesia and nothing left in the neck after the treatment is completed, we have gone far toward inducing that state of mental tranquillity which is one of the prime essentials to success, no matter what procedure is employed. The simplicity and thoroughness of this form of treatment commends itself to the patient no less than to the therapist who employs it, and it seems reasonable to suppose that once its merits are generally comprehended, the voices which are now being lifted up here and there to declare that *hyperthyroidism is not a surgical disease*, will be swelled into a world-wide chorus.

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## A STUDY IN PALEOPATHOLOGY<sup>1</sup>

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**P**ALEOPATHOLOGY is that branch of comparative pathology which deals with evidences of diseases as found in the remains of ancient and extinct organisms. Pathological conditions have affected both animal and plant organisms from very early geological times. This phase of comparative pathology has been neglected; little has appeared in medical publications upon this subject and but little more in technical geological publications.

It is not our intention to enter into a discussion of geology further than is shown in the accompanying chart (Fig. 1) which shows the various geological periods in their correct sequence and comparative lengths. A short examination of this chart will suffice to renew the memory as to the essential details.

We wish in this presentation to call attention to the similarity of several pathological conditions in the earlier geological periods to those now in existence, and to the continuation of these conditions through these long periods of time. To this end we have made a study of such material as we have been able to obtain, have compared it with recent pathological conditions, and are presenting the results of our researches, with some of the original material, photographs, and roentgen films. The material of the Pleistocene Period of the Cenozoic Era is from the Rancho la Brea deposit, in Los Angeles, and shows excellent detail in films, it having been deposited in asphalt and thus preserved but not mineralized. The other material, from various sources and older geologically, is mineralized and can not be radiographed. Both types of material show clear evidences of definite pathological change. In some cases we

have normal specimens for comparison with the pathologic.

It is well recognized that many anatomical structures and physiological functions arose in the early geological periods and have persisted with but little change throughout the intervening ages, and we believe that many pathological conditions arose likewise, and that similarities of persistence, change, and modifications may be comparable to those of anatomy and physiology.

Group No. 1: Dental pathology; consists of mineralized specimens:

- No. 1. The mandible of a Mastodon, Trilophodon, of the Pliocene Period; fracture through the tooth socket, ununited, slight repair beginning.
- No. 2. Incisor tooth of a small camel of the Pliocene Period which shows caries, apical absorption, and osteo-dentine formation.
- No. 3. Fused deciduous and permanent teeth of *Diceratherium Cookii*, a rhinoceros of the Pliocene Period.
- No. 4. Fused deciduous and permanent teeth of *Aphelops*, a rhinoceros of the Pliocene Period.

Group No. 2: Dental pathology; consists of four specimens from the Pleistocene deposit in the Rancho la Brea pits, in Los Angeles, California, and with other material of this kind was obtained through the courtesy of the Los Angeles Museum of Natural History.

- No. 1. Mandible of *Canis Dirus*, giant wolf, showing caries of three teeth, with apical abscesses and root absorption.
- No. 2. A similar mandible showing three teeth, with apical abscess, root absorption and osteomyelitis.

<sup>1</sup>Presented before the Radiological Society of North America, at Milwaukee, Nov. 29-Dec. 4, 1926.



- No. 3. Left superior premolar of Pleistocene horse, showing caries, root absorption, and wear due to age.
- No. 4. Left superior molar of Pleistocene horse, showing caries.

In this series of nine original specimens presented here [in Scientific Exhibit], and the photographs of two specimens not presented, we show: Fracture of mandible through tooth socket of Mastodon, Trilophodon, of Pliocene Period, ununited and with little evidence of repair. The animal must have lived but a short time after this injury and fallen prey to either starvation or to predatory beasts. Two cases of impaction of permanent and deciduous teeth in different species of rhinoceri of the Pliocene, the *Diceratherium Cookii* and *Aphelops*. In each of these cases the existence of both teeth is very evident and the lines of impaction are plain. Four cases of pyorrhea with root absorption: the first, an incisor of a small camel of the Pliocene, which shows caries, apical absorption, and osteo-dentine formation; the second and third, two mandibles of *Canis Dirus*, the giant wolf of the Pleistocene, each of which shows caries, apical absorption, and limited osteomyelitis; the fourth, the left superior premolar of the Pleistocene horse which shows caries, root absorption, and wear due to age. A fifth specimen of this series, the left superior molar of the Pleistocene horse, shows simple caries.

In addition, we have the photographs of a mandible of the *Tanyorrhinus Blairi*, a giant hog of the Eocene Period, which shows unmistakable evidence of long-standing pyorrhea, with accompanying osteomyelitis. This specimen is in the Colorado State Museum of Natural History, Denver, and we could not obtain it, as it is a part of a skeleton being prepared for exhibition, though we were permitted to study and photograph it.

Another very interesting photograph is

from the Museum of the University of Nebraska, Lincoln, of the mandible of *Merycodus Necatus*, a primitive deer, of the Miocene, which shows suggestive evidence of actinomycosis, though we are not ready to make that diagnosis without further study.

It will thus be seen that these oral conditions, which are so common now, are not of recent origin as is so often stated, but have existed since the development of mammalian life and even back into the Mesozoic Era or Age of Reptiles. A more complete study of these instances of dental pathology has been prepared and will be published in the near future.

Group No. 3: Osteo-arthritis of productive or arthritis deformans type, with one example of the destructive or tuberculous type of osteo-arthritis. Mineralized specimens.

- No. 1. Fused caudal vertebrae of an unidentified mammal of the Pliocene Period.
- No. 2. Fused lumbar vertebrae of *Pliobanthenia* (camel), of the Pliocene Period.
- No. 3. Destructive type of arthritis, vertebrae of *Diceratherium Cookii* (rhinoceros), placed in this group for convenience in handling, is discussed in Group No. 5, which it resembles.
- No. 4. Productive arthritis, vertebra of *Entelodon* (giant hog), of the Oligocene Period.

Group No. 4: Osteo-arthritis of the productive or arthritis deformans type, all of Pleistocene Period.

- No. 1. Fused lumbar vertebrae of saber-tooth tiger, *Smilodon Californicus*.
- No. 2. The same, of another individual of the same species.
- No. 3. Productive arthritis involving body and spinous process, vertebra of saber-tooth tiger, *Smilodon Californicus*.

DOCTORS F.B. YOUNG & A.L. COOPER SCOTTSBLUFF.					
PSYCHOZOIC age of man 100,000 years			RECENT	ANIMAL LIFE all that now in existence or recently extinct.	DISEASES those at present in existence
CENOZOIC age of MAMMALS 3,000,000 to 10,000,000 years			Pleistocene	This era is the time of develop- ment of mammal- ian life. In the early part this type began to be pre- dominant, and this predominance increased with each succeeding period...	Fractures, Simple & compound, with inf- ection, and with ex- cessive callus; <i>Periostitis; Osteomy- elitis; Osteitis; Os- teoma; Necrosis; ... Carious teeth; De- formed teeth, Pyo- rrhea, Arthritis of various types.</i>
			Pliocene		
			Miocene		
			Oligocene		
			Eocene		
MESOZOIC age of REPTILES 6,000,000 to 12,000,000 years			Cretaceous	During this time the Reptiles were the predominant type of life and... attained many dif- ferent forms and characteristics. In the later parts mammalian life began.	Fractures, Simple and Comp- ound with or without excessive callus or infection. <i>Pyorrhea; Dental Caries; Dental deform- ities; Periostitis; Osteomyelitis; Osteitis; Osteoma; Hemangioma; Arthritis of various types; Opisthotonus, and certain lesions not yet explained</i>
			Jurassic		
			Triassic		
PALEOZOIC 12,000,000 to 20,000,000 years - Age of Amphibians Fish and Invertebrates			Permian	<i>In the early part of this era the Inver- tebrates were the pre- dominant type. These... were followed first by the fishes, and later by the amphibians. All types at- tained many forms, some of which were gigantic &amp; dis- tinct. Reptilian forms first developed in the latter part of this era.</i>	Fractures of various types Dental Caries; Dental Deform- ities; Pyorrhea; Osteomyelitis; Osteitis; Osteoma; Periost- itis; Parasitism. During this era there was abundant development of Bacteria and fungi, some of which may have been Pathogenic, and some Sym- biotic.
			Carboniferous		
			Devonian		
			Silurian		
			Ordovician		
PROTEROZOIC 31,000,000 to 51,000,000 years				UNICELLULAR And very Simple organisms <i>In early periods no evidence of life of any kind has been found</i>	
ARCHEOZOIC 51,000,000 to 110,000,000 years				NO LIFE EXISTED	

Plate 1. Geological chart showing typical animal life and pathology found in each period.

Group No. 5: Osteo-arthritis of destructive or tuberculous type.

No. 3 of Group 3 is an example of this type, a vertebra of *Diceratherium Cookii*, a rhinoceros of the Lower Pliocene Period, showing destruction of the intervertebral disc, with erosion of the bone and "mushrooming" of the vertebral body, an almost typical case of Pott's disease.

A photograph of the acetabulum of *Teleoceras*, a reptile of the Jurassic Period of the Mesozoic Era, shows the typical destructive condition of tuberculous hip joint disease. Nos. 1, 2 and 3 of Group 5 are the cervical, dorsal, and lumbar vertebrae of three different individuals of saber-tooth tiger from the Pleistocene, each of which shows the pathology suggestive of tuberculous spondylitis. We realize that it is not possible to designate these conditions definitely as tuberculous spondylitis, but we can say that the pathology resembles this.

Osteo-arthritis of both destructive or tuberculous and the productive or arthritis deformans types are thus seen to have existed from antiquity in practically the same forms in which we meet them now. It will be noticed that the vertebra of *Diceratherium Cookii*, rhinoceros of the Pliocene, and the three vertebrae of the saber-tooth tiger of the Pleistocene each show typical destruction of the disc and adjoining bone structure, with spreading and "mushrooming" of the vertebral body so characteristic of Pott's disease in the human. One of these Pleistocene specimens shows, in addition, a certain amount of new bone formation, or a mixed type of bone lesion suggestive of implantation of mixed infection upon tuberculosis. It may, of course, be possible that these lesions were caused wholly by septic organisms following injury, but such does not seem probable after careful examination of the condition of these bones. A photograph of the acetabu-

lum of *Teleoceras*, a large reptile of the Jurassic Period of the Mesozoic Era, shows typical tuberculosis-like destruction of the joint in such a manner as to strongly suggest tuberculous hip joint disease.

Of the productive or arthritis deformans type, we have the vertebra of the giant hog of the Oligocene, the fused caudal vertebrae of the unidentified mammal, the fused lumbar vertebrae of the large camel of the Pliocene, the two examples of fused vertebrae of the saber-tooth tiger, one which is not fused, but shows a productive condition with lipping of the body of the vertebra and thickening of the spine—all of which cases are at least strongly suggestive of arthritis deformans as we recognize the disease in our practice to-day. These conditions have evidently not followed direct traumatism and infection with pus organisms, as neither careful examination nor X-ray films shows any evidence of bony injury. It is interesting in this connection to call attention to the dental conditions previously referred to as evidence that focal infections existed in these bygone days and may have been as potent in the causation of joint pathology as they are to-day. Typical examples of both Pott's disease and arthritis deformans have been reported in early human remains from many sources, and we have in our possession a print of the roentgen film of an early Egyptian mummy which shows definite arthritis deformans.

Again, we see a beautiful continuity of pathological conditions, beginning in the Oligocene Period and continuing to the present. We regret that we have not been able to secure a complete series of specimens of either tuberculous spondylitis or arthritis deformans spondylitis of recent humans for study and comparison, though we have examples of both such conditions in the extremities, and if anyone here present has such specimens and will part with them we will appreciate the receipt of them. In our private collection and study we are endeavor-

oring to build up a comparative collection of each pathological condition from each geological period, and of human and lower animal recent material of each type, and to succeed in our somewhat isolated position we must have the help of our friends and others who are interested in this subject.

Group No. 6: A series of fractures and periostitis.

- No. 1. Fracture of rib of *Symborodon Titanothera* from the Lower Oligocene Period, showing good healing but excessive callus formation.
- No. 2. Fracture of tibia of unidentified mammal of Miocene Period, showing septic osteo-arthritis.
- No. 3. Fracture of phalanx of *Alticamelus* (giraffe-camel), of Lower Pliocene, well healed but with deformity.
- No. 4. Fracture of rib, *Titanothera* of Eocene Period, well healed, with normal amount of callus. This is the oldest specimen geologically in this exhibit.
- No. 5. Osteo-arthritis of phalanx of *Hipparion* (horse), of Pliocene Period; probably septic, following injury.
- No. 6. Periostitis and productive osteitis of phalanx of *Alticamelus* (giraffe-camel), of Pliocene; probably septic, following injury.
- No. 7. Osteitis, probably following fracture, of metapodial of *Hipparion* (horse), of Pliocene.
- No. 8. Exostosis, probably septic in origin, of toe bone of *Diceratherium Cookii* (rhinoceros), of the Pliocene Period.

Also photographs of the following material which is not in our possession: Fracture of scapula, with deformity and hypertrophy, of *Androdemus Fragilis*, a carnivorous Dinosaur of the Jurassic Period of the Mesozoic Era.

Fracture, with deformity and excessive callus, metacarpals of the Duck-billed Dinosaur of the Jurassic Period.

Fracture of horn of *Triceratops* (Horned Dinosaur), of the Cretaceous Period of the Mesozoic Era.

Exostosis of unknown origin on the right scapula of *Triceratops* (Horned Dinosaur), also of the Cretaceous Period.

Group No. 7: Fractures, all cases except the one human being Pleistocene, from Los Angeles, California.

- No. 1. Fracture of tibia and fibula of human, recent, with malposition and deformity and infection; placed here for comparison.
- No. 2. Fracture of humerus of *Canis Dirus* (giant wolf), with malposition, deformity and infection.
- No. 3. Fracture of fibula of saber-tooth tiger, with slight deformity and infection.
- No. 4. Fracture of rib of saber-tooth tiger, with excessive callus and infection.
- No. 5. Ununited fracture of phalanx of saber-tooth tiger, with infection.
- No. 6. Fracture of rib of giant wolf, normally healed, with small callus.

It will certainly be granted that even the worst of these cases must have lived for a considerable time after the accident to carry the healing processes as far as are here shown, and to have lived must have been able to avoid or conquer enemies and to obtain food. There may be some practical application in this knowledge of Nature's methods of healing, at least some curb upon the over-enthusiastic treatment of some forms of fracture. Certainly the human tibia and fibula shown here present but little better result than the humerus of the wolf on the same film.

In this series of fractures we have a most



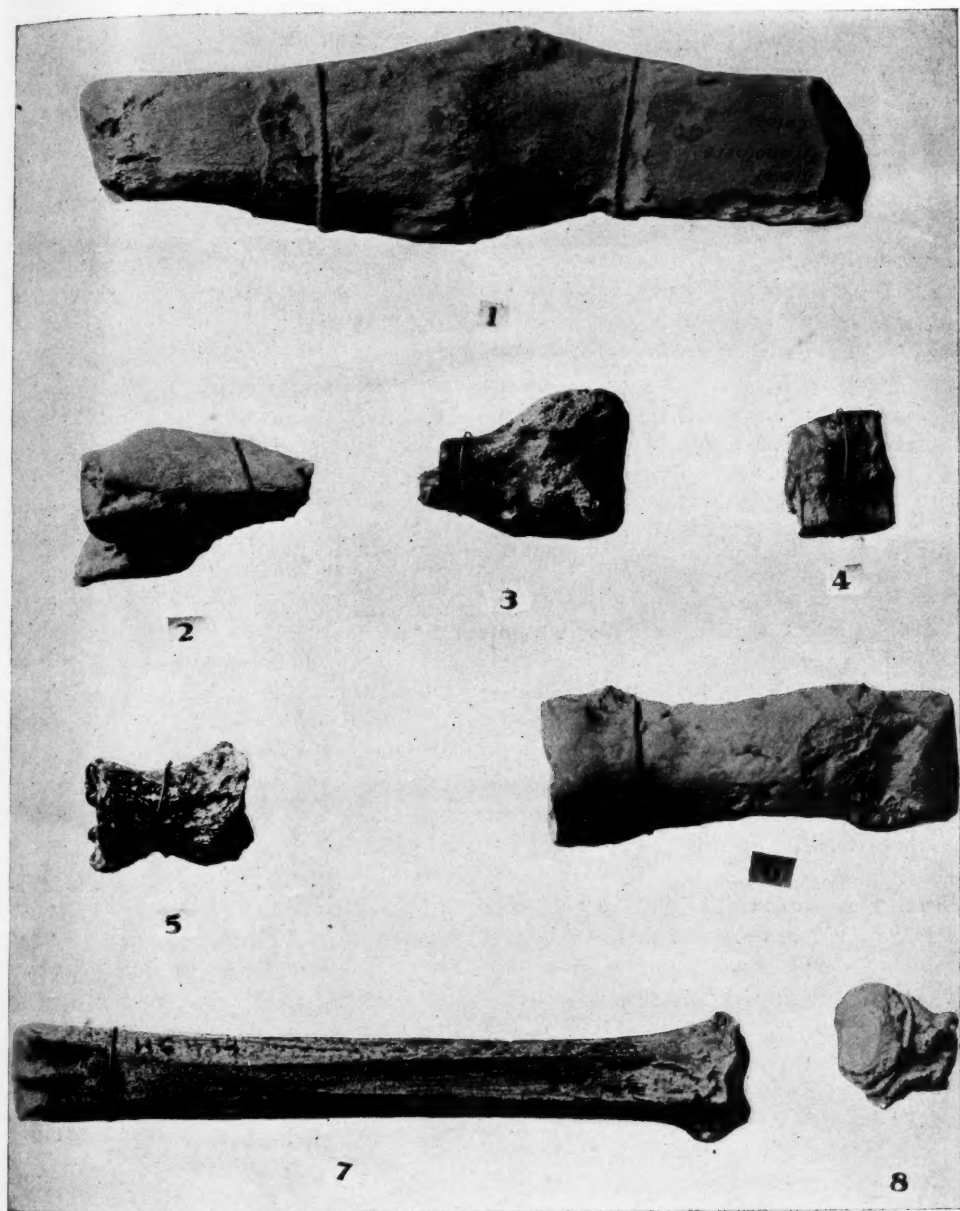


Plate 2. Group 6: Specimens showing (a) fractures and (b) periostitis. (1) Fracture of rib of *Symborodon Titanotherium*, from Lower Oligocene Period, showing good healing but excessive callus. (2) Fracture of tibia of unidentified mammal of Miocene Period, showing portion of fibula, fused; osteo-arthritis. (3) Fracture of phalanx of *Alticamelus* (giraffe-camel), of Lower Pliocene; well healed but with deformity. (4) Fracture of rib of *Titanotherium* of Eocene Period; well healed, with normal amount of callus. This is the oldest specimen, geologically, in this group. (5) Osteo-arthritis of phalanx of *Hipparion* (horse), of Pliocene Period; probably septic, following injury. (6) Periostitis and productive osteitis of phalanx of *Alticamelus*, of Pliocene; probably septic, following injury. (7) Osteitis; metapodial of *Hipparion* (three-toed horse), of Pliocene Period; probably from injury near proximal end. (8) Osteitis and exostosis of toe bone of *Diceratherium Cookii* (rhinoceros), of Pliocene Period; probably septic in origin.



varied and interesting study, beginning geologically in the Mesozoic Era or Age of Reptiles and extending almost without interruption to a recent human case. The pathological conditions, the repair processes and the results are almost identical the one with the other.

Of the fractures with noticeable deformity or infection we have in geological order the metacarpals of the Duck-billed Dinosaur of the Jurassic Period of the Mesozoic Era and the scapula of *Androdemus Fragilis*, a carnivorous Dinosaur of the same period; a rib of the *Titanotheres* of the Lower Oligocene; various bones of the giraffe-camel, the *Hipparion*, the *Diceratherium* and of an unidentified mammal, all of the Pliocene Period; a humerus of the *Canis Dirus* or giant wolf; a rib, fibula, and phalanx of the saber-tooth tiger, all of the Pleistocene Period of the Cenozoic Era, and a recent human tibia and fibula.

Of the well-healed fractures with small callus we have but few, these being the horn of *Triceratops*, the Three-horned Dinosaur of the Cretaceous Period of the Mesozoic Era; a rib of a *Titanotheres* of the Eocene Period, and the rib of a giant wolf of the Pleistocene Period.

Many of the mounted skeletons in paleological museums show instances of fractures more or less perfectly healed, so that this condition must have been rather common in ancient days, a fact which is not surprising when we consider the stress of living and viciousness of battles that must have taken place. Probably the most interesting observation in this series is the efficient functional result that must have been attained in most of these cases, despite the strenuous conditions of life.

Group No. 8: Bone tumors; all from the Pleistocene deposits of California.

No. 1. Osteoma of ulna, giant wolf.

No. 2. Myositis ossificans of radius of giant wolf.

No. 3. Myositis ossificans of human fibula, recent, placed here for comparison.

Nos. 4 and 5. Osteoma of femur, giant wolf, which has been sectioned lengthwise.

In the bone tumors, the earliest is the photograph of the right scapula of the Three-horned Dinosaur of the Cretaceous Period of the Mesozoic Era, which has exostosis, of unknown causation, on its mesial surface. It is suggested that this is the result of injury. There are numerous cases of exostoses of apparently septic origin following traumatism, in various specimens of this collection, which have been classified under other headings because the other conditions seemed to us to be the more important. But we have three cases of definite bone tumor: first, an osteoma of the ulna of the giant wolf; second, myositis ossificans of the radius of the giant wolf; third, osteoma of femur of giant wolf, and, for comparison, a case of myositis ossificans of a recent human fibula. While the cases of osteomata of the ulna and femur of the wolf may have been caused by traumatism their appearance suggests that they are not of such origin; and while it is so certain that the myositis ossificans was caused by injury that you can imagine the tooth marks of his antagonist upon his bone, yet the type of bone tumor is so definitely of this character that we feel justified in classifying it as a true tumor, remembering also that cases of this type of tumor are the direct result of trauma. The roentgen study of this series is very enlightening and shows detail of both tumors and adjoining bone structures with remarkable clarity. We hope to add more specimens of this type to our collection and to be able later to give a report of our microscopical studies. It will be interesting to learn definitely as to the origin of these tumors. Tumors as a class have been but little reported in paleopathology and the study given them is wholly insufficient. So

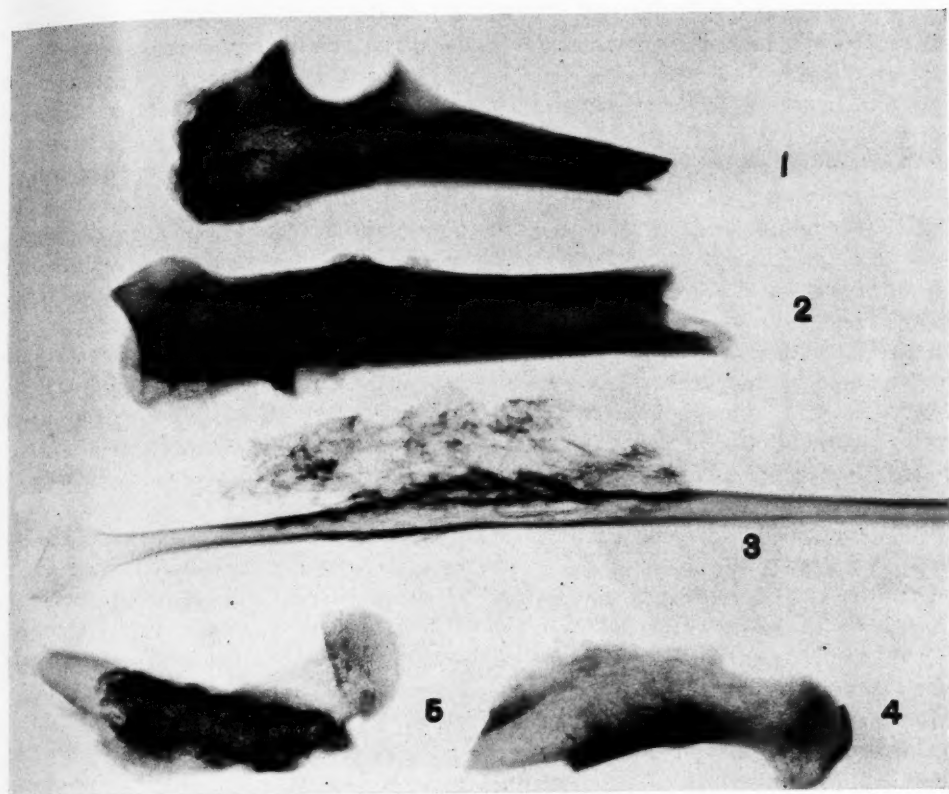


Plate 3. Group 8: Radiographs of bone tumors. (1) Osteoma of ulna; *Canis Dirus*, Pleistocene Period. (2) Myositis ossificans of radius; same. (3) Myositis ossificans of human fibula; recent. (4 and 5) Osteoma of femur, sectioned; *Canis Dirus*, Pleistocene Period.

far as we are aware, no cases of malignancy have been reported, but it will not be surprising if more careful study develops the existence of both primary sarcomata and secondary carcinomata. At least this phase is worthy of careful investigation.

Group No. 9: Osteomyelitis; all from Pleistocene deposits in California.

- No. 1. Osteomyelitis, with eburnation and hypertrophy of ulna of saber-tooth tiger.
- No. 2. Osteomyelitis following fracture; tibia of giant wolf.
- No. 3. Osteomyelitis of rib of saber-tooth tiger.
- No. 4. Osteomyelitis of rib of saber-tooth

tiger; this specimen has been sectioned to show sinus formation.

- No. 5. Osteomyelitis of rib of saber-tooth tiger.

We also show a number of photographs of fractures of various kinds and osteomyelitis of specimens not in our possession.

This group of cases of osteomyelitis shows all the characteristics that may be found in an assorted and fairly complete collection of osteomyelitis cases of the present day. The case of the ulna of the saber-tooth tiger is one that shows a process of long standing and slow development, with ivory-like hypertrophy; other cases show a more fulminant condition; some show that they have followed fracture; some show fine

examples of sinus formation. As a basis for comparison with modern conditions it is of much interest.

Group No. 10: Osteo-arthritis; all from California Pleistocene.

- No. 1. Normal sternal segment of saber-tooth tiger, for comparison.
- No. 2. Septic osteo-arthritis of calcaneum of giant wolf.
- No. 3. Destructive osteo-arthritis of second phalanx of saber-tooth tiger.
- No. 4. Productive of osteo-arthritis of cuboid of saber-tooth tiger.
- No. 5. Productive osteo-arthritis of astragalus of giant wolf.
- No. 6. Productive osteo-arthritis of sternal segment of saber-tooth tiger.
- No. 7. Periostitis of cuboid of giant wolf.

Group No. 10 is a mixed collection of small bones which shows various types of inflammatory bone and joint lesions, all of which are readily comparable to recent pathological conditions. These conditions are discussed in other parts of this paper.

We also present a small collection of fossil wood, which shows the ravages of moulds, insects, worms, and decay exactly as does modern wood.

We present here the specimens of at least twelve different clinical entities ranging in geological age from the Eocene Period of the Cenozoic Era to the present day, and photographs of similar conditions extending back into the Mesozoic Era, and from the literature we learn that many of these conditions extend still farther back, most of them even to the dawn of vertebrate life. In most cases these show pathological lesions readily comparable to those of our present-day diseases. Of the twelve, four are of dental or oral pathology: fracture of the mandible; carious teeth; pyorrhea; impaction of permanent and deciduous teeth, and osteomyelitis of the mandible.

There are three distinct types of osteo-arthritis—the productive or arthritis de-

formans type, the destructive or tuberculous type, and the septic type.

Of fractures there are five results: those well healed without deformity or excessive callus; those well healed with excessive callus; those healed with marked deformity, but without infection; those healed with both deformity and infection, and those not healed. Certainly such a variety as this is more than enough to satisfy any practising surgeon.

Of bone tumors there are apparently two types: those definitely following injury, as the case of myositis ossificans, and those seeming not to have been the result of injury, as in the cases of the ulna and femur of the wolf.

Of the cases of osteomyelitis and periostitis there are apparently two varieties: those which are the direct result of trauma, and those apparently not of such origin, but seemingly having arisen from a blood-borne infection, as is so common in our daily practice.

It is interesting to note that these cases show such a variety of diagnosable conditions over such an immense period of time and that these diseases are so comparable to those of to-day. It is, of course, impossible to designate an ancient case of destructive arthritis as tuberculous, but we are safe in saying that it is of tuberculous type; nor may we say that the cases of ankylosed vertebrae are arthritis deformans as we understand the etiology of the disease at present, but it is permissible to say that they are examples of that type of disease. Neither is it possible to assert that the cases of osteomyelitis and periostitis are septic, for we do not know the character of the infecting organism, but we do know that these cases present every evidence of having been infected with our ordinary pus-producing organisms.

The classification of micro-organisms is based upon their growth characteristics, their staining qualities, and their morphol-

ogy. It is impossible, of course, to secure the first two in material of this character, and the morphological characteristics may be so changed by fossilization as to be either useless or misleading, even when the organisms may be found. In many cases the cellular structure is perfectly preserved and microscopic examination is quite satisfactory, though the technical difficulties of preparing such specimens are enormous, so much so that we have been disappointed by not having a sufficient number to make their showing here worth while. We have carried this investigation along while engaged in quite active practice of medicine and surgery and have not been able to do all the things we wished to accomplish.

We do not know yet how great may be the value of the study of this branch of comparative pathology, though it seems that a knowledge that such conditions have existed from the time of development of vertebrate life to the present, in practically unchanged forms, should throw some light upon these various diseases when such knowledge is fully developed and wholly understood.

Our researches lead us to believe that, along with anatomical structures and physiological functions which developed early in geological history, there developed certain diseases that are also still continuing to exist in recognizable form. In short, we believe that the ancient cases of dental pathology were due to the same conditions that cause them to-day; that the cases of vertebral destruction were due to tuberculosis; that the cases of ankylosed vertebræ were from the same causes that develop arthritis deformans at present, whatever those causes may be; that cases of periostitis and osteomyelitis developed from both external violence and from blood-borne infection from some distant point in the body.

Paleontologists are inclined to place human origin farther back as their investigations become more complete, and it is prob-

able that many of the diseases of present-day humanity owe their origin to the diseases we are considering here, many of which undoubtedly existed long before man became an inhabitant of this earth. It is of further interest to note that there has been little or no development of immunity to these classes of diseases throughout all this time, and this will lead us to surmise that no such immunity may develop in the future.

The material which is available for study in paleopathology is a relatively small part of the total of pathology which must have affected these animals, for the reason that only the hard parts have been preserved, all soft tissues having undergone destruction. Bone pathology is a small part of total pathology under any circumstances, but with such definite persistence of bone conditions as we find in fossil forms it is allowable to believe that the pathology and diseases of the soft parts also were analogous with and similar to, if not distinctly identical with, the pathology and diseases which exist at present in both man and lower animals. It is within reason to conjecture that these ancient organisms were subject to many of the infectious diseases, some of which may have assumed epidemic proportions and may thus have accounted for the sudden disappearance of some of these species.

It is, of course, granted that changes in climatic conditions, with the corresponding changes of food and air compositions, were responsible for many of the extinctions of faunal and floral life, as was also overspecialization upon the part of some species; but so far as we are able to learn there was not sufficient change in conditions to explain the complete disappearance of the horses, camels, elephants, sloths, the great vultures, and other animals that were apparently so abundant in North America throughout the Pleistocene Period. Certainly many of the Pleistocene species, or their lineal and but slightly changed de-

scendants, have survived and are with us now. Nor is it probable that migration would explain this complete disappearance, for though it is admitted that many, in fact, a majority, of any species might migrate, it is almost unthinkable that every pair, male and female, would go marching away two by two, as the animals entered the Ark, and leave the country wholly depopulated of these tribes. Is it not more probable that fatal epidemic diseases came up to destroy the greater or the lesser remnants of these species, possibly already weakened as races and individuals by the previously mentioned factors, and, as such, that diseases were the true and ultimate cause of these extinctions?

Another interesting study would be that of the bearing of diseases upon ancient and modern history and upon the development of civilization. A little attention has been paid to this subject, but it is deserving of far more. Certain it is that disease has been a greater factor than has been generally credited, and that it has not always been an unfavorable factor to human kind.

#### DISCUSSION

DR. M. J. HUBENY (Chicago): I want to thank Dr. Cooper for this essential hobby that he has given us, and I regret to say that I am not able to add anything to it—only a few logical deductions, some of us might make. The very fact that we have comparative anatomy, I think, establishes at once that we have comparative pathology and, inferentially, comparative physiology.

I looked at the Doctors' exhibit and enjoyed it very much, and if any of you have not seen it, you really ought to, because it is well worth while. I am sorry I cannot add anything, but I want to thank the Doctor for the paper he has given us.

DR. R. H. STEVENS (Detroit): I do not know why I was asked to discuss this very interesting paper, except that I like to get out and read in the Book of Nature as Dr. Cooper and Dr. Young do. I really think it is a great diversion. Some of you who spend much of your time on the golf course might find that a search for, and study of, some of these paleontological diseases, like arthritis deformans, are just as interesting as that little ball you chase around the green, and of much more educational value. You know scientific work consists in the collection, classification, and correlation of facts, and the interpreting of them; that is what Dr. Cooper and Dr. Young are doing at the present time. What help these observations are, when we find that the saber-toothed tiger and the giant wolf, away back ten or more million years ago, suffered from the very same diseases that prevail now in the genus *Homo*, I cannot tell you; but perhaps after we get a lot of these facts classified and correlated we may find that they are of some value in helping us to understand similar diseases in man of the present day. So while it now seems only like very interesting material without much practical application, it may prove to be very useful later on.



## THE IMPORTANCE OF TEETH IN ROUTINE GASTRO-INTESTINAL EXAMINATIONS<sup>1</sup>

By FRANCIS B. SHELDON, M.D., STOCKTON, CALIFORNIA

IN the last few years it has been my practice to inspect the mouth of patients referred for gastro-intestinal examination. Having seen the large fillings, and finding many crowns that have been placed for a number of years, I have suggested the raying of the teeth. In the cases of approximately 85 per cent of those patients, who, following the suggestion, have had dental films made, there have been found alveolar infections.

Now it is recognized by the medical profession at large that infections of the teeth or tonsils may be the cause of arthritis, and many do not think of a focal infection unless they are confronted with this same arthritic condition. Others believe that focal infections are the cause of much of the muscular rheumatism, and many of the neuralgias and cardiac conditions. Granting that these conditions may be secondary to the alveolar infections, why may not gastric and intestinal conditions also be secondary to the same condition? In the case of a patient having pyorrhea, every time food is masticated some of the pus is squeezed out of the gums into the food and passes directly into the intestinal tract. This, then, is a chronic source of infection and it is possible that the stomach may not be able always to care for it, especially if there is an intercurrent condition that lowers the normal resistance of the patient. In the case of the apical abscess the toxins or the bacteria may be transferred through the blood stream to an area of lowered resistance in the intestinal tract. Here, again, the normal condition of the body may take care of the condition till such time as there

is a general lowered resistance and then the gastric symptoms begin to appear.

Ofttimes when the attention of the referring physician has been called to possible sequelæ arising from the condition of the teeth, he has referred the patient to a dentist, who, by inspection of the proximal surfaces, has pronounced the teeth to be in good condition. This cannot mean that there is no alveolar infection, for it is impossible for the dentist or physician to tell what is below the gumline without X-ray films. Many times when one is inspecting the mouth the patient will volunteer the information that he has recently visited the dentist and the teeth have been pronounced to be in perfect condition. (Questioned as to whether or not the dentist used the X-ray in the examination, the patient will reply, "No.") In my experience some of these patients have been found to be carrying around a half-dozen or more abscesses, and some have been seen with one root completely detached by caries.

Many patients coming for examination report indefinite symptoms of trouble in the abdomen, and others with definite ulcer symptoms are found on examination to be negative for gastro-intestinal pathology as far as can be demonstrated with the X-ray. Most of these patients will be found to have foci of infection in the alveolus. That these patients become free of their abdominal symptoms following the removal of the infected teeth, has been seen in a number of instances.

J. A. Kolmer<sup>2</sup> says: "To not a few physicians the subject of focal infection begins and ends with the possibility of a deforming arthritis being related to infected teeth or

<sup>1</sup>Read before the Radiological Society of North America, at Milwaukee, Nov. 29-Dec. 4, 1926.

<sup>2</sup>Focal infection from the laboratory standpoint, John A. Kolmer, Jour. Am. Med. Assn., Sept. 11, 1926, p. 824.

tonsils, the removal of which may or may not be followed by a magical disappearance of the joint involvements." Again, he says: "According to my experience, infections of the apexes of the teeth, the nasal accessory sinuses, tonsils and bronchi are the most important primary foci in adults. Even in some of those cases of gall-bladder and bile-duct infections believed to be secondary foci, I believe that infections of the upper respiratory tract are of primary importance, followed in sequence by secondary infection of the intestinal tract and of the biliary passages through the swallowing of purulent material, or possibly by direct blood stream infection of the liver."

TABLE I

Findings of Gastro-intestinal Tract	Findings of Teeth			
	Abscesses	Pyorrhea	Negative	
Negative	40 <sup>3</sup>	27	12	1
Peptic Ulcer	6	4		2
Patent Gastro-enterostomy				
Opening	1	1		
Pathological				
Gall Bladder	24	17	3	4
Biliary Calculus	4	2	1	1
Duodenal Ulcer	9	6	2	1
Adhesions	4	1	2	1
Hyperperistalsis	3	2	1	
Pathological				
Appendix	20	12	3	5
Cecal Adhesions	2	2		
Pyloric				
Obstruction	1		1	
Enlarged Heart	1	1		
Pelvic Tumor	1	1		
Carcinoma	1	1		
	117-100%	77-66%	25-21%	15-13%

Thirty-four per cent of the total of 117 cases in this series show no gastro-intestinal pathology, but of these only 1, or 2.5 per cent of these, is negative for alveolar infection. Of the total, only 15, or 13 per cent, are negative for alveolar infection. Now, many patients who undoubtedly had alveolar infection did not have the teeth roentgenographed, so these are in a manner picked cases; yet I believe they are close to the normal figures. Many of these cases of

alveolar infection were not suspected by the referring physician, and in some only one focus of infection was found.

## TYPICAL PATIENTS

Mrs. W., age 47, came complaining of pain in the stomach two or three hours after meals, also much gas in the stomach following meals. This woman was thin, due to the fact that she was not eating as she should have been, her symptoms having persisted for a good many months. The gastro-intestinal examination was entirely negative for any evidence of pathological lesion. Inspection of the mouth showed many teeth with large fillings, several crowns that had been placed for many years, and several teeth missing. The X-ray films showed many abscesses, and pyorrhea. She was advised by her physician to have these teeth out. Following the removal of the teeth all the abdominal symptoms disappeared, the patient began to gain in weight, and has been well since, now a period of several years.

Mrs. F. O. E., age 35, referred for a gastro-intestinal examination, complained of pain in the upper right quadrant, and much gas in the stomach. Roentgen examination showed the stomach to be negative. The upper border of the duodenum had a large permanent crescentic depression which was diagnosed as a gall-bladder pressure on the duodenum. Examination of the teeth at this time showed pyorrhea, and seven teeth with apical abscesses. When these teeth were removed all abdominal symptoms disappeared; however, the duodenal defect was still present five months after the first examination. At this time the patient was feeling well and was gaining in weight, clinically cured of her abdominal distress by the removal of the oral foci of infection.

Mrs. E. B., age 37, complaining of gas in the stomach and a nervous twitch, was referred for gall-bladder examination. With

<sup>3</sup>I was interested in the report of C. G. Sutherland, during this meeting, to the effect that 70 per cent of the gastro-intestinal examinations at the Mayo Clinic were negative. *RADIOLOGY*, February, 1927, pp. 111-116.

the dye, the gall bladder was found to function normally. There was no evidence of calculus or other gall-bladder pathology. Films of the teeth showed several apical abscesses and pyorrheal erosion about the molars. This patient had been under observation in a hospital for a month, during which time the teeth had not been inspected. However, within three weeks after the removal of the alveolar foci of infection the nervous twitching had disappeared and there was no more complaint of gas or distress in the upper right quadrant. The history showed that this patient had submitted previously to several abdominal operations without relief of her symptoms.

If the removal of the alveolar infections will clear up the abdominal symptoms, without any other medical or surgical interference, may not the presence of these same infected foci account for the persistence of symptoms following the surgical removal of the local lesion, as in the case of this patient? Also, if the mouth is the origin of the abdominal trouble and lesion, will they not tend to recur if the alveolar foci are not removed? I can see no reason for the secondary lesion not recurring.

I firmly believe that the examination of the alveolar processes should be included in the routine gastro-intestinal examination, and I therefore make a plea for the inclusion of these findings in our gastro-intestinal reports.

#### DISCUSSION

DR. M. J. HUBENY (Chicago): As was to be expected, a paper that pertains to a dental discussion has a very small audience. As a matter of fact, we have thirty or more teeth in our mouths and a number of roots on some of them, and a habit of putting on a beautiful gold crown or some chinaware. We must consider it from the standpoint of the individual; we have to take into consideration the question of metastasis. I would

not pretend to say anything about the mechanism, but the things we have to deal with are pyemia, septicemia and sapremia. The only time medical men consider a metastatic process is when they are dealing with a malignancy, but that comes once, while dental infections come very often. I believe very heartily in what Dr. Sheldon has stated, that dental infection may be the cause of almost any kind of condition, either as a contributory factor depending upon a predisposing tendency or possibly as an initial cause of disease. I think the most elusive factor we have to deal with is the absence of pain: that is the joker of it. If you have no pain around the tooth, you think the tooth is perfectly all right; but how many times do you see malignancy and tuberculosis and lymphomas and pernicious anemias and yet the patient has practically no pain? So you have to discount the question of pain.

Rosenow has shown the specificity and transmutation of organisms and reported finding them in the gastric mucosa and the mucosa of the alimentary tract. Then Dr. Haden came along with his wonderful experimental research work and showed us that up to a given point the X-ray is all right, and beyond that it does not give any information; in other words, it is not a microscope. I might cite the five instances given in one of his papers, because anything that goes back to dentistry apparently is thrown in the waste basket: we are all interested in gastric ulcers and mediastinal tumors, but forget about teeth. Dr. Haden had five dental films; under each dental film he had a test tube. The teeth were extracted under surgical asepsis. The first film showed a tooth in which there were distinct X-ray findings—probably a granuloma. Below this was a test tube with a culture of this particular tooth—he found various kinds of fixed organisms. The next tooth looked even worse—we might say it

was an abscess—the bone pathology was even greater than in the other one. He made a culture and at that given moment it was absolutely sterile. On the next film he had a pyorrheal tooth which was devitalized; on extraction he got nothing. The X-ray showed practically nothing. The next tooth was a pyorrheal tooth in which the X-ray showed nothing, but it was supposedly a vital tooth. That culture showed a lot

of organisms. The next showed a little decalcification around a retained root and a lot of organisms showed in the tube. I do not think X-ray men ought to be willing to make a conclusion from the X-ray findings alone. Teeth may cause any kind of pathology, and I believe Dr. Sheldon is perfectly right when he says that films of the complete denture ought to be made in all gastrointestinal examinations.

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## EXPLOSIVE FRACTURES OF THE UPPER END OF THE HUMERUS<sup>1</sup>

By LYELL C. KINNEY, M.D., and A. E. ELLIOTT, M.D., SAN DIEGO, CALIFORNIA

**F**RACTURES of the upper end of the humerus usually leave a certain amount of permanent disability. The typical result is limited abduction and restricted external rotation, which impairs any function of the arm above the horizontal plane. There are several causes for this disability, the chief of which is incomplete anatomical reduction. Complete reduction is difficult because the small upper fragment is uncontrollable both as to alignment and rotation. A functional result requires that the shaft be brought into alignment with this uncontrollable fragment, and that both fragments be returned to their normal positions around the long axis. This ideal of anatomical reduction has been stressed greatly since the war and has completely changed the treatment of fractures in this region. A second feature of equal weight has not been emphasized in the recent literature. We believe that it is a determining element in the final disability and that it is one of the most important factors in handling these fractures. This is the fact that comminution of the head frequently accompanies fractures of the upper end of the humerus and makes them primarily joint fractures.

The structure of the head of the humerus renders it subject to frequent comminution from fractures in this region. The upper end of the humerus is composed entirely of cancellous bone; there is practically no cortex, as the cortex of the shaft stops at the surgical neck. The shell enclosing the head is approximately 1 mm. thick, not much thicker than the fine underlying trabeculae. The cancellous structure is limited below by the surgical neck and forms practically a true sphere. In frac-

tures of the upper end of the humerus, this cancellous ball is abruptly forced against the acromion process. If the greater tuberosity does not give way, there is a break through the surgical neck or just below. The fracture through the surgical neck tears off a segment of the cancellous sphere and usually the crushing or the avulsion of this lower segment results in explosive fragmentation of the entire sphere. The globe of cancellous tissue behaves as any other brittle ball, and destruction of any part of the circumference results in more or less complete destruction of the sphere.

The frequency of this comminution of the head was brought to our attention in the cases that came to open reduction. Practically all the cases operated on for fracture of the surgical neck demonstrated this disruptive fragmentation of the head. Dr. M. C. Harding, of San Diego, from whose service most of our material is taken, states that he has rarely operated on a fracture of the surgical neck of the humerus without finding an extensive comminution of the head. In order to check these findings we have restudied the films in 40 cases of fracture of the surgical neck. In 70 per cent of these films we have been able to find definite fracture lines throughout the head. In recent films taken to show sharp detail in architecture, nearly all of the fractures of the surgical neck show that explosive fragmentation of the head accompanies avulsion of the lower segment of the cancellous sphere. In contrast to this it was noted that this fragmentation was not seen in simple fractures of the tuberosity and was seldom present in fractures below the surgical neck.

Roentgen laboratory reports seldom mention this coincident injury to the head. In reviewing the reports of two San Diego hospitals for the past eight years it is only

<sup>1</sup>Read before the Radiological Society of North America, at Milwaukee, Nov. 29-Dec. 4, 1926.



occasionally mentioned and then when there was gross deformity. It has been overlooked because we did not know that it was a frequent occurrence and did not look beyond the major injury. Also, it has been overlooked because of indifferent films or films taken through dressings that showed satisfactory outlines in the major fracture but did not show fine architecture.

The X-ray finding of fragmentation of the head is based on a study of the cancellous architecture. The usual comminution of the head does not cause marked deformity in outline and the cortical shell is so thin that points of discontinuity are not easily discernible. There is little displacement of fragments and hence little irregularity in outline; thus it is necessary that the films show in sharp detail a clean-cut architecture in the cancellous network. As good detail is essential as that demanded in the alveolar process in dental films or the cellular structure of a mastoid. Where it is possible, films in perpendicular planes, that is, in both internal and external rotation, will uncover more fracture lines than the one stereoscopic pair.

Fractures in the head of the humerus show themselves by discontinuity in the architecture of the cancellous network. There may be fine lines of separation between or across the trabeculae. There may be lines of blurring of the architecture caused by the slight overlapping of fragments. There may be completely detached fragments that appear as inlays interrupting the lines of architecture. These lines may or may not cross the fine cortical shell in the plane observed. When they do there is often little or no accompanying irregularity in the outline. By tracing these flaws in structure we may find extensive fragmentation, even in a head that shows perfect outline. The picture is that of an irregular mosaic of lines, either increased or decreased in density, interrupting the orderly architecture of the cancellous structure. When taken to the

operating room it will be seen to represent a mass of loosely attached fragments, even though there is little external deformity of the contour of the head.

This fragmentation of the head accompanying shoulder injuries plays an important part in the final disability, and its presence should influence the treatment. Laying aside the other factors that have been fully covered in the recent literature, the explosive fracture of the head of the humerus presents four indications to be considered.

(1) *Its relationship to the difficulty in reducing gross displacement of the major fracture.* The loosely held mass of fragments forming the head offers no solid abutment against which to hook or to hold the displaced shaft. There is no way to control the position or rotation of the fragmented head, and manipulation of the shaft against it is usually futile. Even when the fracture is exposed, manipulation of the shaft by external pressure is likewise futile, and it is nearly always necessary to pry the fragments into position through the open wound. Any but the gentlest maneuver will crush and displace the small spongy fragments and tend to distort and widen the head; thus, in the presence of comminution of the cancellous ball great care should be used in effort at manipulation. If gentle manipulation or prolonged extension does not effect good alignment, these cases should be operated on early and without destructive and futile attempts at closed reduction.

(2) *Comminution of the head makes any fracture in this region primarily a joint injury.* This means fracture of the articular cartilage, joint hemorrhage, and later linear excrescences of joint callus and joint adhesions. As elsewhere, such fractures are preferably treated in extension. Also, very early, painless motion is indicated, to prevent adhesions and to keep the callus at a minimum. Certainly by the second week these fractures should have frequent, painless, active and passive motion and this

should be continued throughout the period of repair.

(3) *The loose fragments of the upper end of the humerus are subject to displacement by lateral traction from the attached muscles.* If these rotators are not relaxed, their lateral torque causes distortion and enlargement of the fragmented mass. Positioning of the arm to relax these muscles will not only stop the distortion pull but will also cause the fragments to approach their normal position. Thus the fragmentation of the cancellous globe emphasizes the modern theory of treatment in wide abduction and external rotation, with the consequent relaxation of the attached rotators.

(4) *Where there is extensive comminution of the head, this mass of fragments may be wedged apart by the upward thrust of the shaft of the humerus;* this is especially true if the upper end of the solid shaft is more or less pointed. The tense longitudinal muscles force the shaft upwards against the cancellous ball, and the loosely comminuted fragments are forced apart, increasing the size and deformity of the head. We believe that the comminution of the head is thus an indication for treating these fractures with early lateral extension. This will permit the shattered mass of spongy fragments to solidify before being forced to support the shaft against muscular tension.

It is not the purpose of this paper to define the proper treatment of fractures of the upper end of the humerus, but these factors are noted to show the relationship of explosive fragmentation of the head to the final deformity and disability.

In reporting X-ray films of fractures of the upper end of the humerus we have found it necessary to search for and describe the entire injury instead of discussing only the major fracture. We wish to emphasize the fact that an explosive fragmen-

tation of the head frequently accompanies fractures in this region, especially fractures through the surgical neck of the humerus. An essential prerequisite is to procure films that show sharp detail in the cancellous structure and preferably films in perpendicular planes. It must be borne in mind that fragmentation of the head often gives little or no deformity in the contour and is shown only by the presence of discontinuity in the architecture of the cancellous globe. Such an appreciation of and description of the entire injury is essential in the X-ray report. A recognition of this explosive injury in the head accompanying shoulder fractures will materially lessen the resulting permanent disability.

#### DISCUSSION

DR. CHARLES A. STEVENS (Chicago): I think there is very little to be said in addition to what Dr. Kinney has said. He stressed the comminution of these interesting fractures of the surgical neck. I think they occur more often in fractures of the anatomical neck; in opening up fractures we have found more comminution in the anatomical neck. It usually occurs in older persons, the bones being more brittle. In addition to what Dr. Kinney has said, we have been taking X-ray films in two positions, by abducting the arm, placing the tube in the axilla, and by placing the plate over the shoulder, in that way getting a true lateral view. If there is any displacement of the fragment at all, it will be seen on one of these films, anterior posterior or true lateral. As Dr. Kinney says, there is very seldom displacement of these fractures, but when there is, by taking two films at right angles, you will get the displacement that shows, and see the fragments in the lateral view that you do not see in the anterior position now.

## CASE REPORTS

### PAROTID FISTULA: CASE HISTORY

By I. S. TROSTLER, M.D., CHICAGO

Several years ago Dr. Orndoff and Dr. Ivy did some experimentation upon dogs in an effort to determine what effect roentgenization had upon the salivary glands. They proved that the effect was always depressing upon the secretory function, and so reported their findings. I was privileged to be present when some of this experimental work was being done and was impressed with the painstaking care exercised in the details of the work, little thinking that it would ever have any application to therapy in my hands.

Parotid fistulae are notoriously difficult to heal, and when they occur in operation scars such as those following a mastoid operation, where the area is near a bony wall and nerves, operative measures to cure them are not lightly undertaken. This is evidenced from the following case, which was referred to me by an ear surgeon.

Patient, girl, 8 years of age, small, dark skinned, of southern European parentage. Four years before she had had a radical mastoid operation on the left side and within the next four months had had two other mastoid operations on the same side. She was in the hospital from October 18, 1922, to May 30, 1923. On January 13, 1926, examination revealed a small opening behind the left ear, just posterior to the tragus, which for the past two and one-half years had been discharging a clear, transparent fluid. Analysis of the discharge proved it to be saliva, and the diagnosis of parotid fistula was confirmed. Various methods undertaken to induce healing and closure of fistula had failed. In June, 1925, radium had been applied, without benefit.

On January 13, 1926, at 2:30 P. M., I administered 60 milliamperes-minutes (6 ma.

for 10 min.), at 70 K.V.P., 12 inches anode skin distance, filtered through 5 mm. sole leather and 3 mm. aluminum. At 11 A. M. the next day the area was dry, and the mother of the patient said that it had been dry since 7 A. M. that morning, *for the first time in two and one-half years.*

The area was again slightly moist on the tenth day following the treatment (January 23), and on February 8 the same dosage was applied, with the result that the discharge dried up and the sinus healed. The gland resumed its function (as nearly as could be determined) after another ten days, but in the meantime the sinus had had time to contract its lumen and fill with granulations. No further evidence of the discharge is recorded.

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### INJECTION OF PILONIDAL CYST WITH LIPIODOL

By JULIUS BRAMS, M.D., Roentgenologist St. Elizabeth Hospital, CHICAGO, ILLINOIS

Sacrococcygeal fistulae are not uncommonly encountered and may be confusing as to their exact character. Discharging fistulous tracts of tuberculous, pyogenic, or osteomyelitic origin may thus be confused with the common pilonidal cyst unless some means is had of determining the extent and location of the sinus. In one such case which came to our attention we injected lipiodol into the fistula, with a very satisfactory result. Because of the possible value of lipiodol in this connection and because we know of no other report of this kind, we believed that the case would be of interest to other roentgenologists.

Pilonidal cysts, sacrococcygeal dermoids, or epidermoids are of congenital origin and

usually contain retained hair along with some retained sebaceous material. Such a cyst may cause no symptoms, but, following an injury, infection or both, it may become the seat of a chronic discharge, continuing until the entire cyst is removed. These cysts are located in the median line over the sacrum and coccyx and may have more than one opening: our case had two. They are of importance not only because of the discharge from them, when infected, but in that they may communicate with the neural canal, and, unless this is known, their surgical removal may be accompanied by some difficulties.

It seemed to us that by injecting the sinus with lipiodol and tilting the patient with the head down we could determine the nature and extent of the cyst as well as any possible connection with the neural canal. The accompanying roentgenograph (Fig. 1), we believe, gave us the desired information. Undoubtedly a study of a series of such

cases would yield some interesting and useful information.

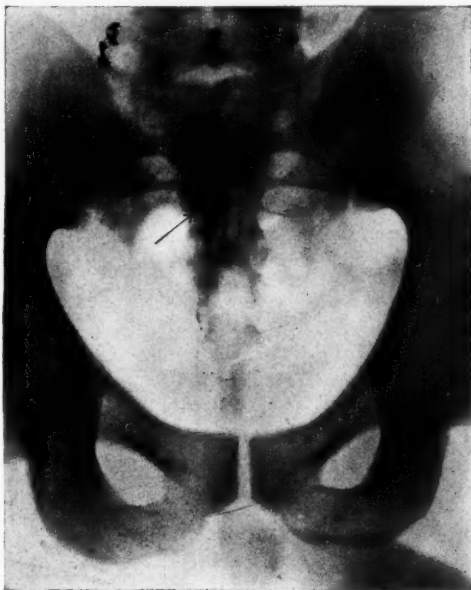


Fig. 1. Injection of pilonidal cyst with lipiodol, showing type and extent of cyst.

# EDITORIAL

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## RADIOLOGY IN GROUP PRACTICE

It has been said that the physicians of former times were better and keener diagnosticians than those of to-day because they necessarily relied solely upon their personal powers of observation, whereas to-day the tendency is to "pass the buck" to some laboratory test or so-called instrument of precision.

The great diagnosticians of the last century were men who through the highest cultivation and utilization of the powers of observation afforded by the special senses of sight, hearing, touch and smell accumulated a vast collection of clinical pictures of disease which, together with their innate mental ability, enabled them when confronted with a given disease picture to give a name to it.

Their minds were so attuned to its recognition that the diagnosis was almost effortless on their part in many instances, although it partook of the miraculous to their less observing colleagues, who, not knowing the disease picture when they saw it, could not conceive of or name it.

The instinct for collecting is one of the most characteristic attributes of man. Many successful men, as boys, have been interested in collections of one kind or another. Under the stimulus of an incessant desire to add new specimens to their collections, they were impelled to gain such a knowledge of the characteristics of the longed-for objects

that their minds were alert to the instant recognition of them when chance or search brought them to view. The acquisition of some new or greatly desired specimen was accompanied by a thrill of pleasure which amply repaid them for their efforts. The keener minds developed such powers of observation that their collections were constantly enlarged, often at the expense of duller minds that did not recognize the intrinsic value of the specimens when they saw them.

The making of a correct diagnosis in an obscure case is an achievement which carries with it, in addition to its other rewards, the same gratifying sense of attainment which the successful youthful collector enjoys. The art of diagnosis is a collectors' game in which mental pictures of disease entities, embracing histories and physical findings, illumined by the light of experience, replace material objects; in it is the expression and exchange of opinions, valuable in direct proportion to the balanced judgment and interpretative ability of the examiners. The rewards of increasing clientele and professional success then are awarded to those who are able to score the highest percentage of correct diagnoses.

Thousands of women died of ruptured tubal pregnancy before the clinical picture became a part of the collection of the majority of physicians. Innumerable patients to-day are suffering from unrecognized hyperthyroidism and many are afflicted with undiagnosed hypothyroidism. That even the giant diagnosticians of the past could see only according to their light and were blind to many of the, to us, unmistakable evidences of distinct clinical disease entities, is very apparent when we think of the actual incidence of acute appendicitis, duodenal



ulcer, and so forth, not to mention the long list of lesions whose presence is demonstrable with the requisite exactness only by the aid of the roentgen ray.

The end of the last and the dawn of the present century ushered in many laboratory aids in the field of diagnosis, signaling the union of an old art and a new science, the microscope, laryngoscope, cysto-, broncho- and various other "scopes," including the fluoroscope, together with various refined laboratory methods of making so-called scientific exact diagnoses. The disciples of the laboratory school of diagnosticians, once "in the saddle," have ridden so fast and furiously that, to the uninitiated and especially to the inexperienced and helpless medical student, it must seem that the ultimate goal of medical endeavor and achievement is the attainment of a mechanical diagnostic omniscience machine. The average layman's conception of the miraculous power of an X-ray machine *per se* to automatically portray and label the various ailments of the human frame but reflects the pseudo-scientific atmosphere emanating from the commercialized laboratories of this new aspirant to diagnostic prestige.

Unquestionably the greatest achievement of the true physician or surgeon is the art of correct diagnosis. Treatment, especially operative treatment, based on a faulty or erroneous diagnosis may leave the patient in a worse state than the ailment for which relief was sought. Any method of examination or laboratory device which will in the slightest degree militate against the chance of diagnostic error is a great boon and should be utilized to the greatest possible extent.

In making use of these aids to diagnosis a proper appreciation of, and regard for, several factors is imperative:

1. The quality of the apparatus.
2. The ability and experience of the technician.

3. The experience, probity, and diagnostic acumen of the interpreter (the personal equation).

To the experienced surgeon the report by a pathologist (of unknown repute) that the tissue shows a sarcomatous change, no longer carries the weight of infallibility which the name "pathologist," attached to a report, engendered a few years ago. Pathologists differ as regards the personal equation. The microscope does not change the quality of the gray matter in their brains. The able pathologist bases his diagnosis somewhat on past experiences and on the clinical evidence presented with the microscopic finding, and his opinion is valued according to his past record of correct or incorrect diagnoses.

In brief, then, all the various modern "scopes," including the fluoroscope, are but devices which enable the user of them to extend the range of vision somewhat beyond the normal, the individual acuity of which often in the past differentiated the great diagnostician from the mediocre. The surgeon is, or should be, *par excellence* an able diagnostician. His diagnosis is constantly being checked up. Moreover, he is constantly checking up on the diagnoses made by the laboratory aids, especially the X-ray.

The average surgeon who has been in active practice during the past twenty-five years is in an excellent position to evaluate and appreciate the progress and development of the roentgen ray as an aid to correct diagnosis. He has learned to accept the interpretation of the X-ray laboratory according to the ability of the reporter as evidenced by his past record. In other words, the factor of the personal equation of the X-ray diagnostician is just as important as the personal equation in any other special branch of the art of medicine and is the real basis of the surgeon's acceptance of the report. In the reading of plates the experienced surgeon has acquired a versatility of no mean order. The greater

his ability in this respect the more esteem he has for the roentgenologist who has so perfected his technic that he is able to diagnose and demonstrate the presence of organic lesions not apparent in the plate method of examination. The finding by visualization of a small penetrating ulcer on the posterior wall of the stomach in a patient with a questionable history and atypical symptoms, where repeated examinations by others have resulted in negative reports, is a diagnostic achievement of the first order, an accomplishment of the combined powers of art and science which equals any of the feats of pre-roentgenologic diagnosis. The surgeon who has the happy experience of repeatedly verifying by operative procedures such fluoroscopic diagnoses, considers himself most fortunate in being able to rely on the resourcefulness and diagnostic ability of the consulting roentgenologist.

The making of a good roentgenologic diagnostician is comparable in its essential features to the development of a good diagnostician of the pre-roentgenological era—years of painstaking study and the collection of memory pictures associated with disease entities, corroborated by actual visualization of the lesions at operation or autopsy. In this way only will the master roentgenologic diagnostician arrive. There is the same vast difference between an artist and an artisan in this as in other fields.

Without any question the greatest general benefit to the art of correct diagnosis has been through the development of roentgenology, because of the universality of its application to practically all branches.

The old type family physician was capable of mastering the then existing knowledge of disease and of administering treatment to his patients. His opinion on medical matters was final. Advances in the art and science of medicine became so rapid, however, that it was impossible for one mind to keep abreast of all the progress in the field of diagnosis and treatment of dis-

ease. The development of the various specialties followed, in which certain men devoted their abilities to the diagnosis and treatment of disease in one or more correlated groups of organs. Thus developed the branches of gynecology, neurology, dermatology, urology, and so forth, with a resultant improvement in the methods of diagnosis and treatment which was most apparent. One of the evils of specialization has been the tendency which is humanly inherent of assuming that the specialty in which one is primarily interested is more important and all-embracing than the facts really warrant. This is especially true where the specialist is autocratic and in a position where his judgment cannot be questioned. The value of a report from or a consultation with men of such temperament may be more or less vitiated by lack of the sympathetic co-operation so essential to the unravelling of many obscure diagnostic problems. Fear of adverse criticism, professional jealousies, and so forth, may hamper the free and frank exchange of opinions which characterize the successful teamwork of any co-operative endeavor. A questioning attitude, not critical, but truth-searching in its essence, is better understood and becomes more palatable when the participants are on an equal basis and are jointly interested in finding a solution to the problem at hand.

The laboratory methods of diagnosis are not infallible. The reports may be erroneous or misleading through lack of appreciation of clinical factors which are not in the possession of those making the reports, or by reason of possible mistakes in calculations. There is no such thing as a mechanical or laboratory diagnosis *per se*. The widely varying reports on the basal metabolic rate in cases of hyperthyroidism made by different technicians with different types of machines on the same patient at intervals of a day or two serve to emphasize the importance of the personal equa-

tion in all laboratory diagnostic work. The experienced clinician will discard the report of a normal basal metabolic rate in a patient in whom he finds definite evidence of an incipient exophthalmic goiter. Likewise he will give little credence to a verbose roentgenologic report of a probable duodenal ulcer unless it is substantiated by the history and other clinical evidence.

The psychological value of the continued reiteration of a phrase or cognomen is taken advantage of in every line of business advertising. The flaunting before the profession of medicine and the laity of a sign with the designation "diagnostic X-ray laboratory" on it is in many instances intrinsically fraudulent. One is reluctant to estimate the number of patients in whom the diagnosis of a duodenal or gastric ulcer has been made by X-ray examination, with resultant operative procedures which failed to reveal any demonstrable pathologic lesion. The field of roentgenology is now so broad, embracing practically all the departments of clinical medicine, that the average lone roentgenologist is subject to the criticism which applied to the old type general practitioner of medicine when he professed to be able to make a diagnosis on any and every patient presented to him. This assumed prerogative, by embracing too wide an extent of territory, may result in frequent erroneous conclusions.

Roentgenology is not an exact science but rather a scientific gift of a super-sense of sight which permits of a wide range in the personal deductions and conclusions arrived at through its application. The value of an interpretation of X-ray plates of the chest frequently may depend so much upon a concomitant expert physical examination that the intrinsic value of the method is vitiated or lost without it. A great many patients have been diagnosed by X-ray as having pulmonary tuberculosis and sent to sanatoria for treatment—and found not to have this disease. As judged by autopsy reports

there is still a great deal to be desired so far as concerns our ability to make correct diagnosis of disease conditions in general. Whatever figure may represent the pre-roentgenologic correct diagnostic ability of the profession in general, it may be assumed that the development of roentgenology has added at least 10 per cent to its accuracy and range, and that the future enhancement of its value will come through the intensive efforts of experienced clinicians highly skilled in the art of physical examination in the various specialties, utilizing this adjunct either in a personal way or by collaboration with a roentgenologist, as a consultant.

Undoubtedly the highest percentage of correct diagnoses to-day are made by groups of well trained clinical specialists who are enjoying and profiting by the sympathetic and intimate co-operation of able roentgenologists. The development of a capable roentgenologist under these conditions is one of the most gratifying and satisfactory achievements of group medicine in its highest form, where the one great object is that of arriving at the most correct possible appraisal of the physical condition of any given patient through any and all means of examination, regardless of any other consideration whatsoever. In a congenial environment the individual successful scoring of one particular diagnostic branch in an obscure condition not only brings a thrill of pleasure to the one making the correct diagnosis but brings, as well, a sense of mutual gratification to the group as a whole.

If one of the great diagnosticians of pre-roentgenologic days could attend a modern group conference having under consideration a series of obscure cases including patients afflicted with the various lesions causing dysphagia, others with questionable gastro-intestinal lesions, and so forth, he would be astounded and delighted at each roentgenologic demonstration and laboratory report, with the attendant discussions,

and marveling at the co-ordination of group deductions, expressed in an harmonious atmosphere, permitting of the free and intimate exchange of opinions so essential to the difficult task of arriving at correct diagnostic conclusions, acclaim it as the highest conceivable type of service.

REGINALD H. JACKSON, M.D.

### ROBERT H. MACHLETT

The contributions which the makers of apparatus, the glass blowers and others who devote themselves to the technical problems, have made to the development of roentgenology as an art and a science, cannot be overestimated. In the early days, before the industries concerned with the making of the necessary apparatus were organized, much of the technical advancement depended upon individual workers, whose contributions were fundamental and important. Many of these pioneers have been martyrs, and have suffered and died as a result of their labors.

The recent death of Robert H. Machlett, who can truly be said to have given his life to the development and perfection of the X-ray tube, came as a great shock to his numerous friends in the scientific world.

He was born in 1872 in the town of Galesburg, in the heart of the Black Forest, where for generations glass blowing has been the vocation of the dwellers of the region. After serving an apprenticeship in a large glass-blowing establishment, he came to America at the age of 16, and continued in his occupation at a time when men of his skill and ability were needed. His exactitude and rare judgment in the construction of glass apparatus were keenly appreciated by the research workers. Apparatus that had been considered impossible of manufacture was readily constructed by ingenious methods suggested by him.

His ability as an industrious, reliable and accurate glass blower was recognized by men of science and his work-room was visited by many physicians, physicists and chemists seeking his services in the construc-



ROBERT H. MACHLETT  
(1872-1926)

tion of apparatus of a complicated nature. He was painstaking and accurate; graduated apparatus, leaving his hands to be sent to the United States Bureau of Standards, for certification, was seldom rejected. It was his proud boast that he, personally, had made several pieces of apparatus by which new physical laws were established. One of the numerous types of glass instruments of value in general practice constructed and developed by him is the Doremus Ureometer.

When, in 1895, Professor Roentgen announced his discovery, Machlett was immediately interested and began experiments to reproduce the results of Roentgen. He was



ideally equipped for such work, for just at that time he had perfected a mercury pump capable of producing a very high vacuum. He attacked the difficult task, and before many days had passed succeeded in producing the first X-ray tube in this country. This fact has been recognized and acknowledged by those in a position to know of the work done in the early days. From the very beginning he made many improvements in the construction of X-ray tubes, especially in the dark days from 1895 to 1905. It was then necessary to improve and perfect the tiny and fragile Crookes' tube, so that it might utilize high voltage.

This required skill and thought and imagination. The pioneer must work out his own salvation; he must depend on himself to create something which has not previously existed. Machlett was always ready to give his energy, experience and means to perfect any apparatus which he believed would benefit the profession.

In the days when the static machine predominated, he developed X-ray tubes for this machine. As progress was made with the induction coil, he kept abreast of this development and improved his tubes to take this increased energy of the apparatus.

In 1904, Machlett, working with Dr. Piffard, constructed the first lead glass X-ray tube containing a crown glass window, this limiting the emergent rays to the size of the crown glass window. In 1906, he produced the Cornell Treatment Tube. The water-cooled tube may be credited to his ingenuity.

When the Interrupterless Transformer made its appearance, Machlett was again confronted with the task of making an X-ray tube to take the current from this new type of generator. The X-ray tube made for the induction coil was not suitable; many radical changes in tube construction were necessary. After studying the current characteristics of the transformer, Machlett produced, again, the first X-ray tube for the Interrupterless Transformer. His trans-

former X-ray tubes have been used throughout this country and in many foreign countries.

Besides X-ray tubes and scientific instruments, Machlett made another notable contribution to the medical profession in the glass vacuum electrode. In 1902, he conceived the idea of applying the high frequency current to the body through glass vacuum electrodes. All of the glass vacuum electrodes of to-day, with few exceptions, were first produced by him. The insulated glass vacuum electrode for cavity work was another of his products. Still later, in 1907, he produced a silver plated non-vacuum electrode, but the medical profession at that time did not realize its importance.

The danger of X-ray exposure was not definitely known until about 1905. Prior to that time, it was the custom of all users and makers of X-ray tubes to test the penetration by holding the small fluoroscope with the right hand, and place the left hand in the field of the X-rays. The penetration was determined by the density of the bones of the hand. All of these tests were made without any kind of protection, the tube being clamped only at the cathode neck. In those days there were no such protective devices as lead glass bowls, lead gloves and aprons; no one realized the dangers of X-ray exposure.

When the warning was sounded, it was too late for Machlett; he had exposed himself for many years and considerable damage had already been done. In 1906, keratoses began to appear on his fingers and the back of his left hand. Some of these were destroyed by fulguration. In 1923, the middle finger of the left hand gave him considerable pain. Radium was used in the hope of curing the growth and relieving the pain. It proved ineffective, and, as a last resort, his finger was amputated. A year later the disease spread to his glands, and these were removed. He recovered rapidly from this operation, and felt quite sure that he was



on the road to good health. In the early part of this year, his health began to fail him; metastases appeared in the axilla and chest wall. He bore his disease and suffering with courage and fortitude. He was still interested in his work—the renewed interest in the gas tube, which, he always held, gave results superior to any other type of tube, was a source of satisfaction to him.

His wife took him to Liverpool in the hope that the colloidal lead treatment of Bell might benefit him, but the disease progressed and death claimed him June 1, 1926.

Who will deny him the glory of a brave soldier, who gave his life for humanity? Seared, burned and tortured, surely he will be beautiful in the eyes of God.

I. S. H.

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#### CUBAN RADIOLOGICAL AND PHYSIOTHERAPEUTIC SOCIETY

There has been organized in Cuba a society for the promotion of radiology and physiotherapy, entitled Sociedad Cubana de Radiología y Fisioterapia (Cuban Radiological and Physiotherapeutic Society). Meetings are to be held the first Monday of each month, in Havana. The officers are as follows: Dr. Pedro L. Farinas, President; Dr. F. Rivero, First Vice-president; Dr. A. G. Dominguez, Second Vice-president; Dr. F. H. Bosquet, Third Vice-president; Dr. G. G. Sastre, Treasurer; Dr. M. Viamonte, Secretary; Dr. A. Cabrera, Vice-secretary. The address of Dr. Viamonte is Concordia 64 A, esq. a Lealtad, Havana, Cuba.

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#### CHANGE IN BY-LAWS

##### ANNUAL MEETING, MILWAUKEE, 1926

On page 12 of the By-laws, Article II, Section 2, reads as follows:

"The annual dues for active members, associate members, and members-elect shall be ten dollars (\$10.00), payable on or before the date of the annual meeting, five dollars (\$5.00) of which shall be for the subscription to the journal."

It was moved and passed that this Section 2 of Article II of the By-laws should read:

"The annual dues for active members, associate members, and members-elect shall be fifteen dollars (\$15.00), payable on or before the date of the annual meeting, five dollars (\$5.00) of which shall be for the subscription to the journal."

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#### A NEW JOURNAL

*The Cancer Review—A Journal of Abstracts*, of which Vol. I, No. 1, 1926, has issued from the press of John Wright and Sons, Ltd., Bristol (William Wood and Company, New York, sole agents for the United States), is of interest to all concerned in cancer research and treatment—and who is not? The General Editor is Francis Cavers, D.Sc., M.R.C.S., and the other members of the Editorial Committee are as follows: William Cramer, Ph.D., D.Sc., M.R.C.S., Imperial Cancer Research Fund, London; Cuthbert E. Dukes, M.D., M.Sc., D.P.H., St. Mark's Hospital, London; John Shaw Dunn, M.A., M.D., Ch.B., Professor of Pathology, University of Manchester; Hubert J. B. Fry, M.D., Ph.D., Cancer Hospital Research Institute, London; Major Greenwood, F.R.C.P., M.R.C.S.; Ernest L. Kennaway, M.D., D.Sc., Chemical Pathologist, Cancer Hospital Research Institute, London; Peter J. Kerley, M.B., D.M.R.E., Middlesex Hospital, University of London, and Charles A. Pannett, M.D., B.S., B.Sc., F.R.C.S., Professor of Surgery, St. Mary's Hospital, University of London. On the Management Committee are the names of M. Greenwood, F.R.C.P.,

M.R.C.S., W. Sampson Handley, M.D., M.S., F.R.C.S., W. S. Lazarus-Barlow, M.A., M.D., F.R.C.P., Archibald Leitch, M.D., J. P. Lockhart-Mummery, M.A., B.Ch., F.R.C.S., C. J. Martin, D.Sc., F.R.S., F.R.C.P., and J. A. Murray, M.D., B.Sc., F.R.S.

Under the sponsorship of the British Empire Cancer Campaign, it is devoted to the publication of abstracts and reviews of current contributions to the ever-increasing literature of cancer. As stated editorially, "The idea aimed at will be to include in this Review an abstract of every important publication bearing upon the problems of cancer research in the widest sense."

The abstracts (all signed) are grouped under the heads of General, Experimental and Biochemical, Clinical and Pathological, Radiological, and Statistical, so that the reader loses no time in searching for what he wishes to consult. Full information precedes each abstract as to the publication in which the original paper is printed. In all respects it has the appearance of a valuable aid in the study of cancer.

The following names, on the Radiology Committee, guarantee its interest to readers of RADIOLOGY: Sir Cuthbert S. Wallace, K.C.M.G., C.B., F.R.C.S., A. Burrows, M.D., M. Donaldson, M.B., F.R.C.S., C. Thurstan Holland, M.R.C.S., F. L. Hopwood, D.Sc., Sir Thomas Holder, K.C.V.O., M.D., F.R.C.P., E. H. Kettle, M.D., Robert Knox, M.D., M.I.E.E., Sir Humphry Rolleston, K.C.B., M.D., and Sidney Russ, D.Sc.

#### NEW LOCATION OF RADIUM EMANATION CORPORATION

In order to provide more adequate facilities for meeting the needs of the rapidly increasing number of physicians now utilizing radium emanation therapy, the Radium Emanation Corporation has decided to move

its New York offices, consolidating its executive offices, medical department and laboratories in the new Graybar Building now being erected just east of the Grand Central Terminal, the eastern terminus of the New York Central Lines.

The decision of the Radium Emanation Corporation to move to its new location is due to several reasons; To enlarge its quarters that it may better meet the increasing demand for its products; to provide more ample accommodation for physicians who come to New York for special courses in radiation therapy; to be able to devote an adequate number of rooms to the discussion with members of the medical personnel concerning methods of applying radium emanation and their practical application in the treatment of disease.

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#### RULES OF A COUNTY SOCIETY COMMITTEE ON X-RAY LABORATORIES<sup>1</sup>

If our readers will really take the trouble to go over these regulations they may realize some of the dangers to the common practice of fluoroscopy in physicians' offices and take the proper preventive measures.

The Committee on X-ray Laboratories of the Medical Society of the County of New York have adopted the following rules to serve—

- (1) As a basis for the issuing of permits by the Health Department;
- (2) As a standard to the issuing of permits by the County Medical Society;
- (3) As rules and regulations, safeguarding the health of patients and operators.

1. The director of each X-ray laboratory must be a licensed physician, shall apply to the County Medical Society for a certificate, and shall submit the evidence of approval of

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<sup>1</sup>Reprinted by permission from the *New York Medical Week* and the *Am. Med. Assn. Bull.*

his X-ray laboratory by the Department of Health of the City of New York.

2. Since the practice of roentgenology is a branch of the practice of medicine, the physicians conducting X-ray laboratories shall conform to the code of ethics binding on all members of the profession. This prohibits the giving of a discount, rebate, commission, bonus, contract practice, or any other division of fees.

3. Advertising in periodicals or by means of circulars should, in the interests of the public welfare, be limited to professional cards in medical publications. Professional cards may state the name, address, office hours, telephone, and operator's activities in a fashion similar to that practised by other specialists.

4. The use of a trade name for designating X-ray laboratories directed or owned by licensed physicians is a violation of the Medical Practice Act.

#### GENERAL RECOMMENDATIONS

It is the duty of those in charge of X-ray and radium departments to insure efficient protection and suitable working conditions for both patient and the personnel.

The known effects to be guarded against are—

1. Electrical shocks.
2. Visible injuries to the superficial tissues which may result in permanent damage.
3. Derangements of internal organs and changes in the blood. These are especially important as their earlier manifestation is often unrecognized.

#### PERSONNEL

The following precautions are recommended:

1. Not more than seven working hours a day.
2. Sundays and one half-day off duty each week.

3. An annual holiday of one month or two separate fortnights.

Nurses employed as whole-time workers in X-ray and radium departments should not be called upon for any other hospital service.

In view of the varying susceptibilities of workers to radiation, the Committee recommends that wherever possible periodic test, *e.g.*, every three months, be made upon the blood of the personnel, so that any changes which may occur may be recognized at an early stage. In the present state of our knowledge it is difficult to decide when small variations from the normal blood count become significant.

It is strongly recommended that the X-ray department should not be below the ground level.

The importance of adequate ventilation in both operating and dark rooms is supreme. Artificial ventilation is recommended in most cases. With very high potentials coronal discharges are difficult to avoid, and these produce ozone and nitrous fumes, both of which are prejudicial to the operator. Dark rooms should be capable of being readily opened up to sunshine and fresh air when not in use.

#### DIAGNOSTIC WORK

1. X-ray equipment should not be installed or operated in low-ceiling rooms with overhead piping or in damp or poorly ventilated rooms.
2. Floor space of not less than 100 square feet should be provided in any one room where an X-ray examination is to be made.
3. Cement floors should be covered with cork or other insulating material.
4. Where overhead high tension lines are used they should be of metal tubing not less than  $\frac{1}{2}$  inch in diameter. They should be firmly mounted and extend to the transformer or rectifier terminals.

## THERAPY

5. High tension reel wire should be of fine braided copper without cloth covering, strong enough to stand a pull of not less than fifty pounds' weight.

6. The wires leading to the tube should never be closer to the patient than the tube terminals.

7. High tension reels should be firmly mounted and have proper winding guides to prevent catching when winding and sufficient tension to wind up against a pull of one pound in weight.

8. Foot switches should be used only for fluoroscopic work.

9. In every installation the operating switch should be so placed that a full and unobstructed view is had of the tube. If lead glass windows are provided, they should be large enough to insure such a view.

10. Tables used for radiographic and fluoroscopic work should be of insulating material when practical and the handles of all switches and diaphragm controls should be of such material.

11. Where tubes in more than one room are to be operated from the same transformer, provision should be made so as to make impossible simultaneous operation or closure by any one not in direct charge of the tube or line used. This may readily be accomplished by suitable interlocking switches, or otherwise.

12. Tubes, except the aperture, must be as completely enclosed as possible with a protective material equivalent to not less than  $1\frac{1}{2}$  mm. of lead.

13. The aperture should have a permanent filter of not less than  $\frac{1}{2}$  mm. of aluminum.

14. The tube stand, if metal, should be permanently grounded.

15. *The erythema dose of every set-up, including fluoroscopy, should be predetermined and prominently displayed. No examination should be greater than  $\frac{3}{4}$  erythema dose.*

It must be clearly understood that the protective measures recommended for these various purposes are not necessarily interchangeable; for instance, to use for deep therapy the measures intended for superficial therapy would probably subject the worker to serious injury.

It is difficult to define the demarcation between superficial and deep therapy; for this reason it is recommended that in the reorganization of existing or the equipment of new X-ray departments, the precautionary measures suggested for deep therapy should be followed. (The definition of superficial therapy is considered to cover sets of apparatus giving a maximum of 100,000 volts, 15 cm. spark gap between points; 5 cm. spark gap between spheres of diameter 5 cm.)

It is recommended that—

(1) The therapy room should be well lighted and ventilated, preferably provided with an exhaust electric fan in an outside wall or ventilation shaft. Both the X-ray apparatus and the controls are to be placed outside the room containing the patient.

(2) The walls of the room are to be of material equivalent to not less than 3 mm. of lead. Windows are to be of lead glass of equivalent thickness.

(3) The X-ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 3 mm. of lead.

(4) A separate enclosure to be provided for the operator, situated as far as possible from the X-ray bulb. All controls to be within this enclosure, the walls and windows of which are to be of material equivalent to not less than 3 mm. of lead.

For deep therapy installations, giving voltages above 100,000 and as high as 250,000—

(1) A large, lofty, well ventilated and lighted room to be provided.

(2) The X-ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 5 mm. of lead.

(3) Separate enclosure to be provided for the operator, situated as far as possible from the X-ray bulb, *and the enclosure is not to contain the energizing apparatus.* All controls to be within this enclosure, the walls and windows of which are to be of material equivalent to not less than 5 mm. of lead. *The lead should be covered with pulp board or leather to absorb the secondary radiation.*

#### RADIUM THERAPY

The following protective measures are recommended for the handling of quantities of radium up to one gram:

1. In order to avoid injury to the fingers, the radium, whether in the form of applicators of radium salt or in the form of emanation tubes, should always be manip-

ulated with forceps or similar instruments, and it should be carried from place to place in long-handled boxes lined on all sides with 1 cm. of lead.

2. In order to avoid the penetrating rays of radium all manipulations should be carried out as rapidly as possible, and the operator should not remain in the vicinity of radium for longer than is necessary. The radium when not in use should be stored in an enclosure, the wall thickness of which should be equivalent to not less than 8 cm. of lead.

3. The handling of emanation should as far as possible be carried out during its relatively inactive state. In manipulation, where emanation is likely to come into direct contact with the fingers, thin rubber gloves should be worn. The escape of emanation should be very carefully guarded against, and the room in which it is prepared should be provided with an exhaust electric fan.



# ABSTRACTS OF CURRENT LITERATURE

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**Measurement of roentgen-ray dosage.**

The author points out that the point gap sparkover is most inconstant and does not necessarily represent the voltage passing through the tube, so that the dose on this account, as measured by the McKee-Remer-Witherbee method, may vary within wide limits. The point sparkover varies for the same voltage in transformer construction; as, for instance, in coil and interrupterless transformer. Air density (at sea level and high altitudes), humidity, temperature, corona, variations in shape and size of terminals, the personal equation as to what constitutes a sparkover—all these influence the estimation of the voltage, and, consequently, the dosage, within wide limits. The sphere gap should be used for the purpose of determining voltage for dermatologic therapy. The sphere gap sparkover is influenced only by alterations in air density, the resulting changes occurring in a definite ratio and being readily compensated.

ROLLIN H. STEVENS, M.D.

*Point Gap Sparkover. Variations and Their Effect on Dosage in Superficial Roentgen-ray Therapy.* A. J. Markley. *Archiv. Dermat. and Syph.*, December, 1926, XIV, 704.

**Biological effect of roentgen rays.**

Physicochemical changes in the blood serum after roentgen radiation are already known; for instance, the coagulating rate of albumin and globulin, percentage of fibrin and cholesterin, viscosity, sedimentation velocity of the erythrocytes are affected. In this article, the author presents the results of his study of the behavior of a serological reaction—the so-called alcohol extract reaction after Mertz and Luettge (for technic of this test see *Deutsche med. Wchnschr.*, 1925, p. 1911). Experiments were carried out *in vitro* and *in vivo*. The serum in test tubes or in Petri dishes received from one to four S. U. D. (200 K.V., 3.5 ma., 1.5 Al., 23 cm. F. D.). Of ten normal sera, nine reacted negatively before and after radiation. One serum was hemolytic and reacted positively before and after exposure. Of ten sera taken

from pregnant women, ten were positive following 1 S. U. D., seven were positive following 2 S. U. D.; after 3 S. U. D. only two were positive, while after 4 S. U. D. all sera were negative. Of ten sera taken from malignant tumor patients, all ten were positive after 1 S. U. D., eight were positive after 2 S. U. D., one was positive after 3 S. U. D.; all ten were negative after 4 S. U. D. The experiments *in vivo* were done on 25 cases whose sera reacted positively before X-ray or radium treatment. The blood was taken twenty-four hours before and eight to twenty-four hours after the treatment. Following radium application, twenty were still positive and only five negative, while after roentgen radiation, twelve appeared to be negative, eight questionably positive. It seems, therefore, that roentgen rays have a tendency to change the reaction more than radium. If one can consider the change of the reaction from positive to negative as an indication for a curative effect of the treatment, this test would be a valuable help in establishing the program.

E. A. POHLE, M.D.

*Contribution to the Biological Effect of Roentgen Rays.* Walther Schmidt. *Strahlentherapie*, 1926, XXIII, 681.

**Persistent thymus.**—The thymus is a developmental gland which atrophies after the first few years of life. At times, a great variety of normal atrophy is not affected. Among the symptoms from persistent thymus gland that have been recognized are: convulsions, sudden attacks of dyspnea and cyanosis, spasm of glottis with stridor, breath-holding spells, asthma and retraction of head. Death, in the fatal cases, comes suddenly. The diagnosis is made by X-ray, percussion and palpation in the suprasternal notch. The cause of symptoms has been ascribed to sudden swelling of the gland, nerve reflex, anaphylactic reaction and a number of other causes. The authors feel that sufficient evidence has not been adduced to prove: "(1) that the thymus is the cause of the so-called thymic syndrome in

every case; (2) that the syndrome is due to hyperplasia or enlargement of the gland; (3) that there is an absolute correspondence between actual size of the gland and the X-ray picture of it."

L. R. SANTE, M.D.

*Relation of Thymus to Thymic Syndrome.*  
Mark S. Reuben and Harold R. Fox. *Archiv. Pediat.*, August, 1926, p. 555.

**Pneumoencephalomyelography.**—Neurological clinics are demanding roentgenographic aid in the diagnosis and localizing of brain and cord lesions. About 40 per cent of the brain tumor cases are now operated on without localization clinically. The ordinary roentgenologic examination is of limited value since the majority of tumors begin at a distance from the periphery and escape detection until a later stage.

In order to give real aid, substitution of a rarer medium for the ventricular subarachnoid fluid must be used. Dandy, of Boston, finally adopted air as the simplest and safest medium. His original method was to introduce air during the operation—the direct method. A later method was devised by Dandy, Bingel and Wideroe independently. This consists of withdrawing 5 to 10 c.c. of fluid and replacing it with an almost equal quantity of air, and repeating until the total quantity ranges from 70 to 150 c.c. of air. There is usually a severe headache, nausea and vomiting; sometimes a rise in temperature and, at times, collapse.

The indirect method—spinal route—is of greater value in rendering the subarachnoid spaces visible. The absence or lessening of these spaces suggests pathology. The mortality from the direct method was 9 per cent, but no mortality has been reported from the spinal route. Danger of hernia, especially in posterior fossæ lesions, is mentioned.

The simple apparatus is described and illustrated and the technic is given in detail. Stereoscopic roentgenograms are taken of the head in brain tumors. Positions of the head are described.

In spinal tumors, reproduction in print of tumors up to the level of the trachea have

been made. Because of the air in the trachea, the subarachnoid space is not clearly seen, but the author adopts a different position which is described in detail. The diagnostic value is discussed in normal, syphilitic, obstructive, epileptic and encephalomyelitic cases. The immediate and remote after-effects are described. Excellent prints of roentgenograms are given.

T. R. MORAN, M.D.

*The Value and Safety of a Simplified Method of Pneumoencephalomyelography: Preliminary Report on Use of Special Apparatus in 40 Cases.* Frank Liberson. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1926, p. 231.

**Breast cancer.**—This is report of the five-year results of 175 cases of breast cancer, prepared under the conditions outlined by the American College of Surgeons looking toward the standardization of the reporting of operations and end-results. The report of these cases which was published in November, 1924, followed them for three years, and the present paper takes them through the period which has elapsed since.

The end-results are practically unchanged: one case, earlier reported as alive and well, has developed recurrence, while two, hitherto untraced, have been found to have passed the five-year limit without recurrence. The results achieved have been secured by surgery, with and without prophylactic X-ray treatment. Of recurrent or inoperable cases treated by X-rays alone Greenough has the following to say: "We believe the roentgen treatment of such cases to be of the greatest benefit to the patient, both in prolonging life and in diminishing or entirely relieving distressing symptoms. In fact, the success of roentgen-ray treatment in such cases has made it possible to modify materially the selection of cases for radical operation, and with beneficial results to all concerned." In this connection his final conclusion is: "In the treatment of breast cancer, which is beyond hope of cure by operation, roentgen irradiation offers prospect of relief which can be obtained at present by no other means."

The technic of the treatments, given at the Massachusetts General Hospital under the direction of George W. Holmes, was as follows: 8 or 16 inch distance, 20 cm. field, 8 inch spark gap, 80 K.V., 8 ma., for 5 or 25 minutes, with an aluminum filter (thickness not stated), this giving what was estimated as an erythema dose. Six skin areas were covered, and the post-operative prophylactic cases had the exposures of one series distributed over a period of three to four months. Radical operation the author defines as follows: "The removal of the whole breast, the skin over it, both pectoral muscles, the axillary contents and the deep fascia, from sternum to latissimus and from clavicle to epigastrium. The transverse axillary incision was most frequently employed, and any skin defects were closed by secondary skin graft." Five of the tabulations which accompany and epitomize the paper are based upon results involving this roentgen technic and surgical procedure.

The author credits his successes to the operation rather than to the roentgen irradiation, as might have been expected, his negative enthusiasm for the latter being stated as follows: "Prophylactic roentgen treatment is given, not so much in expectation of increasing the chance of radical cure, as in the hope that if the operation fails, the remaining cancer cells and the surrounding connective tissues may be so affected by the roentgen rays that the cancer tissue may fail to develop for a longer or shorter time." Of the dangers attendant upon post-operative treatment he says: "In the past year two patients have come to my attention who had been operated upon and given roentgen treatment elsewhere. Both had passed the five-year limit without recurrence, but one had a squamous cell carcinoma of the skin of the operative field and the other such advanced chronic roentgen dermatitis and keratosis that removal of the entire affected skin had to be advised. Undoubtedly these patients had been given an overdose of soft radiation, but it is not improbable that this harvest is only just now coming to maturity and that the next few years will show more cases of this nature."

The author considers the matter of grades

of malignancy in breast carcinoma, a subject which he has treated more fully in a previous paper (*Journal of Cancer Research*, 1925, IX, 453).

M. INGLEHART.

*Carcinoma of the Breast: Results of Treatment 1918-1919-1920.* Robert B. Greenough. *Am. Jour. Roentgenol. and Rad. Ther.*, November, 1926, p. 439.

**Thymic enlargement.**—The author warns against operating on children for adenoids and tonsils without roentgen investigation of the chest, for possible enlarged thymus and other chest pathology, since sudden death may occur without any known cause.

During the past two seasons, five hundred children have been examined for possible thymic enlargement in tonsil and adenoid patients. In operative children, enlarged thymus even without symptoms may be the source of danger during anesthesia. Clinical examination cannot easily detect this condition beforehand, but the roentgen examination of the chest is of great importance. The exposure should be for the shortest possible time and a teleroentgenogram is important because it is less distorted. By this means, the heart shadow and thymus may be differentiated in most cases, although there is a possibility of error.

Of the five hundred children examined, twenty-five cases of definite thymic enlargement were found as well as suspicious borderline cases. The positive cases were not operated on, but were treated with X-ray.

Children under three years of age usually show a wide base of the heart which should not be confused with the enlarged thymus unless clinical evidence warrants. In some cases, the thymus may be low over the heart and will not show a characteristic shadow. Radiation is the most satisfactory form of treatment, the surgical treatment having a high rate of mortality.

The paper is well illustrated.

T. R. MORAN, M.D.

*Roentgen Studies of 500 Children for Thymic Enlargement.* C. W. Perkins. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1926, p. 216.



**Duodenal ulcer.**—In the hands of a competent radiologist the percentage of correct diagnoses of duodenal ulcer ranges from 93 to 95 per cent. Ninety per cent of duodenal ulcers occur in the first part, or caput duodenalis. The great majority are situated on the anterior surface. Eighty per cent occur as a single lesion. Ulcers with a crater the size of a large pinhead have been demonstrated radiographically.

Two outstanding methods of radiological examination have been developed. The first system depends almost entirely on the use of the fluoroscope. The second is the method of serial radiography. In the author's work the two methods are combined. A thorough screen examination is done, with the patient in the upright position and then in the prone. Next a series of films is made, ranging in number from twelve to seventeen. About 3 per cent of ulcers gave well marked changes on the film, where the screen showed no abnormality. Conversely, 2 per cent showed changes on the screen, where the film was negative.

The radiological evidences of ulcer are direct and indirect. In the author's opinion the direct evidence—a constantly deformed caput—is by far the most important. This appearance is just as convincing to the radiologist as the view of the ulcer in the opened abdomen is to the surgeon or the section at autopsy is to the pathologist. The deformity is caused by several changes: the crater of the active ulcer, fibrous or scar tissue in the chronic or recurring ulcer, and a certain amount of spasm in some cases. The most common deformity is the "clover leaf cap." Here the ulcer is situated on the anterior surface, with stellate scar tissue radiating to the outer borders. Frequently the deformity is at the base, and consists of one or more notches in the base of the cap, due to the situation of the ulcer close to the sphincter. The classic niche and incisura, so characteristic of gastric ulcer, are often seen in the duodenal. The chronic ulcer may produce so much scar tissue that the caput is virtually destroyed, and so is not visualized. Here we have to depend to some extent on the indirect evidence, namely, gastric

hyperperistalsis and retention, to establish the diagnosis.

Perforation of duodenal ulcer occurs frequently. This process usually being slow, a localized peritonitis develops and the perforation is walled off,—the accessory pocket. This pocket is usually irregular and contains superimposed layers of barium, secretion, and gas. This is in contra-distinction to a duodenal diverticulum, which is smooth, rounded, and contains no gas or secretion. Many other conditions require differentiation from duodenal ulcer.

In deformity produced by adhesions of gall-bladder origin the caput will be angulated upon the pyloric end of the stomach, and is not constant in its appearance. A Morris membrane will deform the caput, but, as this membrane is carried across the pyloric end of the stomach also, there is a similar deformity of the pylorus. A Harris membrane gives clinical symptoms similar to those produced by duodenal ulcer. This membrane never involves the caput, however, being reflected across the descending duodenum. The caput is regular but dilated, and the second part of the duodenum is seen as a broad, flattened ribbon of barium, the valvulae conniventes being absent to a greater or lesser degree.

A drag through the mesentery or the superior mesenteric artery produces a duodenal ileus which clinically simulates a duodenal ulcer. In these cases the caput is normal, but the descending duodenum and first portion of the transverse are dilated. The barium flows back and forward from the caput to the obstruction, eventually passing the latter as a constricted stream. The dilated gall bladder often causes a duodenal deformity, which, however, is smooth and rounded. Pressure from the spine may cause a defect difficult to differentiate. Change of position will cause a change in the appearance of the defect, and in some cases allow the caput to fill well. Duodenal spasm, reflex from an extrinsic cause, such as gall-bladder or appendix disease, will often simulate duodenal ulcer. This may be ruled out by repeated observations at half-hour intervals, or by the use of an antispasmodic.



Indirect evidence of ulcer is of value only as adding to that obtained from the deformed caput. The indirect evidences are: hypertonicity of the stomach, increased gastric peristalsis, variation in emptying time of the stomach (quick emptying in the early non-obstructive ulcer, later emptying in the obstructing type).

Radiology is of value not only in the diagnosing of duodenal ulcer, but also in furnishing the indications for treatment. We are able to indicate whether the ulcer is recent, whether adhesions are forming or stenosis and obstruction are present, thus suggesting whether medical or surgical treatment is advisable.

L. J. CARTER, M.D.

*Duodenal Ulcer: The Radiological Aspect.* W. H. Dickson. *Can. Med. Assn. Jour.*, September, 1926, p. 1053.

**Lipiodol in diagnosis of sterility.**—The author advocates the use of lipiodol as an adjunct to tubal inflation in the diagnosis of sterility. Inflation alone will prove whether the fallopian tubes are normally patent, stenosed, or entirely occluded, but the actual site of the lesion can be visualized by the injection of lipiodol, a chemical compound of 40 per cent iodine in poppy seed oil, which is opaque to X-rays, non-caustic and non-toxic. The injection is simple and painless, and affords a sharp shadow of the cavity of the uterus and the lumen of the tubes. Randall advises its use midway between the menstrual periods, and points out that the indications for it are the same as those for inflation, the contra-indications being infection or hemorrhage. The method seems to be particularly valuable when, with non-patent tubes bimanual examination of the uterus and the history do not provide evidence of pelvic disease, and the question of surgical treatment is under consideration. Notes of three cases are given, illustrating the value of the method in determining suitability for operation, and it is added that it is unjustifiable to subject apparently normal women, whose primary complaint is sterility, to an operation without giving them

the benefit of as accurate a diagnosis as possible. If the site of closure can be located in a given case, the value of an operation can be better determined, since the prospect of success is not good when the obstruction is in the narrowed portion of the tube, but is fair when the lesion is at the fimbriated end, which is the more common finding.

*Lipiodol as an Adjunct to Tubal Inflation in the Diagnosis of Sterility.* Lawrence M. Randall. *Am. Jour. Obst. and Gynec.*, September, 1926, p. 326. (Reprinted by permission from *Brit. Med. Jour.*, Dec. 11, 1926, p. 94 of *Epitome of Current Medical Literature.*)

**Pulmonary tumors.**—Tumors of the lung, including all varieties, constitute a small proportion of lung diseases, yet they appear so often that they call for consideration in all obscure chest conditions. Cancer of the lung, judging from the recent literature, apparently constitutes from 3 to 5 per cent of all cancers, and many authorities now consider pulmonary carcinoma a common form of neoplasm. Greater diagnostic skill and the more general use of the X-ray, no doubt, account for a great part of the apparent increase of lung neoplasms in recent years. Attention is called to a report on 375 consecutive postmortems by one writer, which showed 28 carcinomas, 5 of which were primary in the lung—1.38 per cent of the total deaths and 17 per cent of the carcinomas. The increase of lung cancer is greater than the general cancer incidence; the cause is not definitely established, but chronic lung irritation following influenza is, no doubt, a factor. Considering other new-growths as well as carcinoma, which appear in the lung, it is apparent that pulmonary neoplasms constitute a large problem in chest diagnosis.

The clinical symptoms and physical signs are taken up and discussed in detail; none is considered diagnostic. Bronchoscopy and endoscopy are of great value in the hands of an expert operator. The roentgenologic examination, while not infallible, is considered the

most important when conducted thoroughly, along with a properly taken history. The majority of newgrowths of the lung are malignant; their early detection is essential and the institution of proper treatment imperative. Surgical removal of neoplasms is not promising. Various other measures of treatment that have been used are enumerated, such as selenium, copper, colloidal gold and lead, endocrine therapy and diet. Radiation therapy is recommended and urged as the method of treatment offering the best chance.

S. C. BARROW, M.D.

*Pulmonary Neoplasms: A Discussion of Their Increasing Prevalence, Diagnosis and Treatment.* Charles E. Atkinson. *Am. Rev. Tuberc.*, November, 1926, p. 556.

**Radium therapy.**—The author of this paper is Consulting Aurist and Laryngologist to the Royal Infirmary of Manchester and Surgeon-Laryngologist to the Manchester Radium Institution, both staff positions which bespeak his experience and qualifications to speak on radium therapy in this symposium for the consideration of malignant diseases of the upper air and food passages, at the Annual Meeting of the British Medical Association, recently held in Nottingham. He confines his remarks to the treatment of surgically inoperable growths, in the course of which he says: "Few surgeons have had the courage to employ radium where the growth to be removed appeared to be removable by ordinary surgical procedures, a course of action which at the moment is in consonance with recognized surgical opinion. I venture, however, to say that I look forward to the time when, with improved technic and a more accurate knowledge of dosage and duration of exposure, radium will be used in the type of case which to-day the surgeon claims as his very own."

If the reader concedes Dr. Milligan's right to speak with authority, he may be influenced by the following statement: "In the treatment of inoperable carcinomata two schools of thought dominate the situation: (1) those who believe in large doses and short expo-

sure; (2) those who believe in small doses and long exposures. Having carefully noted in a numerous and varied series of cancer cases the relative merits of both methods, I am myself in favor, in the majority, at any rate, of treatment by small doses and long exposures—exposures running at times to ten, fourteen, or even twenty-one days. For such long exposures it is obvious that the element, and not the emanation, must be used, and this has the disadvantage of locking up large quantities of radium for somewhat prolonged periods, so that its employment is possible only when a moderately large supply of the metal is available." Qualifying this statement somewhat, he goes on to say, "Sarcomata, more especially the rapidly growing variety, are, however, extremely susceptible to small doses of radium applied even for so short a time as twenty-four hours." Recurrence, however, "is by no means unknown." A point to be considered is embodied in the following: "Growths such as sarcomata, more especially the round-cell variety, conforming as they do to embryonic tissue, are readily dispersed, even with short exposures, by suitable doses of either element or emanation. I have, however, been disappointed at times by the subsequent appearance of serious blood changes after its employment. These blood changes are probably of metabolic origin and not the direct result of radio-activity on the hematopoietic organs or cellular elements of the blood."

Of malignant disease of the palate he says that while it is more often than not inoperable, "it lends itself admirably to treatment by diathermy, so much so that I venture to think treatment by radium is rarely called for." He gives his technic for malignant disease of the tonsil as the result of extension from the tongue, the palate, or the faucial pillars. Discussing at length methods of dealing with esophageal carcinoma, he concludes with the fact that "results are far from brilliant" is in large measure due to the radiologist having to base his reports and statistics on cases rejected by the surgeon as inoperable. "Time is the great factor," he says; "in its early stages the disease is purely local, and, if treated at once, curable." While not original, these statements

will well bear repeating. The whole papervious treatment respond less rapidly to further repays careful consideration.

M. INGLEHART.

*The Treatment of Malignant Disease of the Upper Air and Food Passages. III.—Treatment by Radium. Sir William Milligan. Brit. Med. Jour., Nov. 6, 1926, p. 822.*

**Epitheliomata.**—This is a review of 230 case histories of patients treated in the outpatient department of the University of California Medical School between 1920 and 1926, for basal and squamous cell epitheliomata. Of those treated in the skin clinic the greater number received radium therapy, often in conjunction with X-ray, curettage, cautery, desiccation or surgery. In Table I is indicated the incidence of basal cell and squamous cell epitheliomata by decades. Table II indicates the incidence of total basal and squamous cell epitheliomata—70 and 95 per cent, respectively, occur in males. Table III presents the incidence of the growth according to the location of the lesion. Table IV outlines the limits and average duration of time that the lesions had been discovered prior to the application for treatment. Table V shows that of all the cases of the basal cell type, 67 per cent obtained a clinical cure, and of those patients who applied within the first year, 100 per cent obtained a clinical cure. The squamous cell type apparently has a history of less than two years' duration. Table VI classifies the lip cases and Table VII the cases of mouth lesion (other than the tongue).

Conclusions: (1) Squamous cell epitheliomata of the skin occur at an earlier age than do basal cell. (2) Men are two and one-third times as susceptible to basal cell epithelioma and nineteen times as susceptible to squamous cell epithelioma as are women. (3) There are more basal cell than squamous cell epitheliomata of the skin, excluding the ear. Most of the epitheliomata of the ear are squamous celled. (4) Squamous cell epitheliomata grow more rapidly and are more resistant to treatment than basal. (5) A clinical cure is obtained in more basal cell epitheliomata than squamous. (6) Patients having received pre-

treatment than do untreated ones. (7) The older a lesion is the more difficult it is to effect a cure, whatever the pathology. (8) A successful result is very difficult to obtain in epitheliomata involving the mucous membrane.

F. B. SHELDON, M.D.

*Superficial Epitheliomata. C. J. Lunsford and Laurence Taussig. Calif. and West. Med., December, 1926, p. 740.*

**Lavage treatment of posterior sinuses of nose.**—The author describes his lavage treatment of the posterior sinuses of the nose, and explains how it is adapted for examination by radiography. He evolved this method on account of the great difficulty in reaching and investigating the sphenoidal sinus and posterior ethmoidal cells without operative measures. The patient is placed in the supine position and the head is extended at the atlanto-occipital joint until the chin and the external auditory meatus are in the same vertical plane. By this means the sphenoidal sinus becomes the most dependent part of the nasal cavity. Normal saline solution is now allowed to flow into the nose until the ostia of the sinuses are submerged; it does not yet enter the sinuses, as the air cannot escape through the narrow ostium. A suction nozzle is applied to one nostril, the other one is closed, and the tongue and palate are kept in the "K" position to close the nasopharynx. Gentle suction of not more than three pounds is employed, and intermittently released. Each suction draws a bubble of air from the sinuses, and each release allows a drop of fluid to enter the cavity. About a dozen alternations are usually sufficient to fill the posterior group of sinuses. The patient is then returned to the erect position. The fluid remains in the sinuses for from eight hours to several days.

Proetz obtained very satisfactory therapeutic results with saline solution, and has never tried more complicated solutions. The treatment is repeated at intervals of from three to eight days. The sinuses are rapidly cleared of mucus and muco-purulent dis-

charge, and the inflammation subsides. He states that the method is not applicable where there is advanced disease, with polypoid degeneration of the mucosa or bone necrosis.

The method was found particularly useful for diagnosis in conjunction with radiography, and in this case the fluid used was an iodized oil or some similar radio-opaque fluid. The author does not think that there is any danger of infection of the eustachian tubes, since sufficient fluid can be instilled into the nose without reaching the level of the eustachian orifices, and the suction employed is not enough to draw any air out of the middle ear.

*Displacement Irrigation of Nasal Sinuses: A New Procedure in Diagnosis and Conservative Treatment.* Arthur W. Proetz. *Arch. Oto-laryngol.*, July, 1926, p. 1. (Reprinted by permission from *Brit. Med. Jour.*, Nov. 6, 1926, p. 72 of *Epitome of Current Medical Literature.*)

**Bony changes in the hips.**—The author gives a description of early arthritisms, with their symptoms, for the trained eye, namely, a very thin corticalis outlining the bony structures, osteoporosis occurring particularly early in the epiphyses of the long bones, haziness in appearance of the joints. These are, at best, uncertain symptoms upon which to base a diagnosis. But soon, as the lesions proceed, destruction takes place, not only of the bone but also of the surrounding cartilage, with organized opaque deposits taking their place. These unmistakably lead to ankylosis.

Owing to the fact that practically all of the body weight rests upon the hips, we soon find pressure leading to the characteristic bony destruction, affecting the ends of both bones concerned, a condition which the author calls "ulceration from pressure." From this stage to a spontaneous dislocation of the hip is only a step, because the forcible posture in adduction during the inflammatory period enfeebles the play of the muscles and fibers. The author supposes that lesions of similar nature must be more frequent than reported, the chief confusing factor being the striking similarity be-

tween a congenital dislocation and such an old hip disease.

The paper reports three cases, two of which followed childbirth; one was of uncertain etiology. The author mentions also the possibility of pneumococcic infections as described by others, but seems to hesitate to admit that the changes under his personal observation might have been due to the latter etiology.

I. JOSEFSBERG, M.D.

*Radiologic Findings Concerning Certain Arthritisms of the Hip.* P. Moulouquet. *Jour. de Radiol. et d'Electrol.*, March, 1926, p. 115.

**Spondylitis.**—This paper is based on 2,270 spinal examinations of men between twenty-two and thirty years of age. In each case, period of the malady was six or seven years.

**General subjective symptoms:** Dull, aching pain in back, discomfort on lying down, pain more marked on exertion, with slight pain when walking. Pain does not cease when lying down, and is increased by long sitting or standing. Pain may be localized in a joint or referred to the posterior part of leg or anterior part of foot. Onset is gradual, increases through a period of eight to twelve months, when it causes marked discomfort in climbing stairs or on rising from a sitting posture.

**Objective symptoms:** Patients usually stand in a stooped position, with knees slightly flexed. Some present features of a "poker back." The spine is usually held rigid, the hands being used as a support when assuming the erect position. Pain is increased on movement of spine or sacro-iliac joints. Pressure also causes pain. There is definite limitation of motion in the spine. Usually marked spasticity of lower back muscles. Forward movement of lumbo-sacral region is common, and backward movement is impossible. Lordosis invariably absent. Marked kyphosis or lateral curvature was not observed.

**Roentgenological findings:** Gross changes may be divided into three groups: (1) Those



involving a single joint of dorsal or lumbar spine; (2) those in which more than one joint is involved, and (3) sacro-iliac involvement, with or without association with Groups 1 or 2.

The X-ray findings indicate a very low grade type of infection. Two types may be distinguished, active or slowly progressive, and arrested or healed. The earliest X-ray change is a slight degree of joint involvement, as shown by decrease in intervertebral spaces, with slightly hazy articular surfaces. Some cases show similar changes in articular facets. Advanced cases show complete obliteration of the joint space and fusion of opposing bones. In some cases bone hypertrophy is seen, extending into soft parts and indicative of a reparative process.

The X-ray findings in sacro-iliac involvement are similar to those above described and are bilateral in the larger number of cases. Little evidence of bone hypertrophy is found. Differentiation must be made between changes due to typhoid, chronic hypertrophic osteoarthritis and tuberculosis.

The abstractor feels that attention should be drawn to a sentence used by Dr. B. C. Cushway in discussing this paper: "The type of pathology he describes might well be a very early arthritis deformans."

C. H. DEWITT, M.D.

*Spondylitis of Unknown Etiology Simulating Typhoid Spine.* S. C. Woldenberg. *Ill. Med. Jour.*, Dec., 1926, p. 463.

**Urobilinogen in the urine after roentgen irradiation.**—Biological changes in the liver due to roentgen-ray exposure have been observed (Case and Warthin). In order to study the mechanism of this effect, the author has analyzed the urine of patients after exposure to roentgen rays for diagnostic or therapeutic purposes. He found that the urobilinogen reaction is less pronounced in an alkaline urine than in an acid urine. The urobilinogen reaction in the urine is positive after

therapeutic exposure in 64 per cent of all cases, and in 69 per cent after fluoroscopy. As far as the trunk of the body is concerned, it does not make much difference which part is exposed to the radiation. The shortest fluoroscopy suffices to have urobilinogen excreted into the urine. In conclusion, the assumption is made that these observations point to an injury to the liver caused by toxic decay products.

E. A. POHLE, M.D.

*Urobilinogen Excretion in the Urine after X-ray Treatment and Fluoroscopy.* H. Bro-meis. *Strahlentherapie*, 1926, XXIII, 687.

**Roentgenology as related to other medical studies.**—In this, the Caldwell Lecture of 1926, Professor Todd traces the study of anatomy "since the passing of the old order of anatomists," and says to roentgenologists: "No science which has contributed so much as yours has to medical study and investigation, can confine its influence." He is inclined to leave the question whether or not roentgenology should be a separate course in the medical curriculum to convenience and local conditions. Of the method of correlating roentgenology with anatomy and pathology in the school he represents, he says: "Our students are assigned their places in the dissecting room and within ten minutes after this the directions for the barium meal examinations are posted."

To Dr. A. E. Barclay, of the Manchester Royal Infirmary, is given a share in the credit of administering "rude shocks to our ideas regarding the stomach," the standard texts giving up with reluctance the pre-roentgenographic notions of the internal organs; in other words, "Roentgenographic methods have been the chief factor in changing the character of an up-to-date anatomical course."

In the study of epiphyseal union he says that observation of moving joints on the fluoroscopic screen "gives a new zest to the dissection of these parts, almost totally neglected under ordinary circumstances."



The matters of students acting as subjects, of the response of beginners to the stimulus of unfamiliar methods, of the value of roentgenograms of normal individuals secured from the student body, of the relative adaptability of the bodily systems to study (both in the living subject and the cadaver), and of the adjuncts to roentgenography—such as stereoscopic examination and the making of anatomical moving pictures—are handled comprehensively.

M. INGLEHART.

*The Role of Roentgenology in Medical Education.* T. Wingate Todd. *Am. Jour. Roentgenol. and Rad. Ther.*, October, 1926, p. 355.

**Peruterine insufflation for sterility.**—The author discusses the diagnostic value and therapeutic application of peruterine sufflation of the fallopian tubes with carbon dioxide in cases of sterility. The apparatus and technic are described, the most important factors for scientific and safe application being the maintenance of a uniform pressure, rate of flow, and volumetric control. With a uniform rate of flow of 15 seconds to 100 millimeters of mercury, two pulsations of the volumeter generally sufficed to establish a subphrenic pneumoperitoneum, with its associated clinical sensations of epigastric distention and pain in the shoulders and diaphragmatic region. Each pulsation represented from 30 to 40 c.cm. of gas, and though it was found that obese patients might require from three to five pulsations the quantity rarely exceeded 200 c.cm.. The patient was examined radiologically on rising from the table; if the tubes were patent the presence of a single or double sided subphrenic pneumoperitoneum was demonstrated. The author states that with one tube closed the patient will complain of pain on the side of the obstruction, and if both tubes are closed the pain will be bilateral. Such pain is complained of when the obstruction is at any point beyond the isthmus, but when the closure is at the intramural portion of the tubes or very near the isthmus the pain is in the mid-line and referable to the suprasymphysal area.

Rubin found these symptoms so pathog-

nomonic of the site of obstruction as to obviate the necessity for injection of opaque solutions except where operative intervention was indicated. It is claimed that the method has a definite prognostic and diagnostic value in primary sterility when other contributory causes have been eliminated, in cases where there has been previous pelvic infection but which are at the time free from symptoms, and in other conditions in which the tubes have been operated upon. Especially is it of service as a therapeutic measure to eliminate the tubal factor in sterility, and in obscure cases it may obviate the necessity for surgical exploration, since it usually affords a means of determining the patency of the tubes.

*Diagnostic Value and Therapeutic Application of Peruterine Sufflation of the Fallopian Tubes in Cases of Sterility.* I. C. Rubin. *Am. Jour. Surg.*, July, 1926, p. 1. (Reprinted by permission from *Brit. Med. Jour.*, Nov. 6, 1926, p. 72 of *Epitome of Current Medical Literature.*)

**Congenital enlargement of bones.**—The authors have made a fine study of the case of a boy two and a half years old revealing a condition which, according to them, has been unknown until now in X-ray literature. The boy showed no signs of rickets; had never gone through an infectious disease; Wassermann was negative; had no unpleasant sensations which might have been caused by the condition.

A series of roentgenographs taken at different intervals revealed the following findings: The astragalus (talus) was exceedingly enlarged and unusually irregular in shape and structure; the lower end of the tibia was also enlarged. These enlargements were found to be the cause of swelling. Subsequently taken roentgenographs showed no marked further changes in these two bones but, instead, unusually quick development of the nuclei of the scaphoid and the three cuneiforms. The authors also noticed a small longitudinal enlargement of the first and second metatarsals.

No explanation could be given of this

anomaly, to all appearances congenital. Treatment was of no avail.

I. JOSEFSBERG, M.D.

*Enlargement of Bones Forming the Tarsus.*  
Albert Mouchet and J. Belot. *Jour. de Radiol. et d'Electrol.*, July, 1926, p. 289.

**Prostatic neoplasms.**—The author reviews 1,000 cases of prostatic carcinoma treated at the Mayo Clinic up to January, 1925. The average age of these patients was 65 years. In approximately one-half the disease appeared between the sixtieth and seventieth year, in no case was it seen before the forty-second, and in only four prior to the forty-fifth year. Prostatic neoplasms occurring before 40 should be sarcoma. The initial symptoms, mainly those associated with benign hypertrophy of the gland, were frequency, difficulty of urination, and pain. Retention was rare, and gross hematuria was never noted. The later symptoms also simulated those of benign hypertrophy, but in malignant disease there was less evidence of obstruction. The amount of residual urine was comparatively small, the phenolsulphonephthalein readings were high, and, except late in the disease, microscopic examination was of little value. In 243 of the cases metastases were demonstrable, the lymphatic system being the earliest and most frequently involved; next in frequency came the osseous system, especially the sacrum and adjoining portions of the spine and pelvis. Metastases were also found in the lungs, spinal cord, skin, liver, and kidneys. Treatment was surgical, with radium, or a combination of the two.

The results from surgical treatment alone were poor, and Bumpus does not think this form is advisable when the disease has advanced sufficiently to be diagnosed positively. In order that radium treatment might be successful the gland was thoroughly irradiated, the radium being applied through the urethra; emanation-bearing seeds were inserted directly into the gland as well as through the perineum and over the rectal surface. The doses given averaged a little over 2,000 milligram hours. The subsequent average life of the patients

was 22 months. Results were also poor in those cases in which prostatectomy was performed after irradiation of the gland. Thorough irradiation of the prostatic capsule and seminal vesicles following prostatectomy gave encouraging results, and Bumpus believes that this method offers the greatest possibility of cure. When there was but little residual urine the daily use of a catheter was sufficient; if the obstruction was more severe, suprapubic cystotomy was performed, with beneficial results.

*Carcinoma of the Prostate: Clinical Study of 1,000 Cases.* H. C. Bumpus, Jr. *Surg., Gynec., and Obst.*, August, 1926, p. 150. (Reprinted by permission from *Brit. Med. Jour.*, Oct. 9, 1926, p. 53 of *Epitome of Current Medical Literature.*)

**Removable radon seeds.**—This article describes a new method of treating tonsillar hypertrophies by means of removable platinum radon seeds, giving detailed reports of a series of cases where tonsillectomy was for different reasons contra-indicated, and illustrating the application of the technic to varying pathological conditions. To carry out the application of the seeds, a new implanter is used, which is illustrated and described in the article. As the pain of implantation and removal is practically *nil*, at no time is any anesthetic required, there is no need of hospitalization, nor is there disability of any kind. The total absence of shock is a great advantage in inoperable cases. By means of the implanter the operator is able to place one removable radon seed, filtered by 0.3 mm. of platinum, in the center of a tonsil so that radiation is distributed equally throughout. This filtration cuts off the caustic beta rays, thus doing away with all possibility of burning and consequent necrosis and sloughing. When the instrument is withdrawn after implantation the seed is left imbedded in the tonsil with a 2 cm. length of thread protruding from the portal of entry. This short thread does not in any way inconvenience the patient, nor cause the slightest interference with function. At the end of four days the seeds are easily removed by grasping the threads with forceps. The point

of the trocar is so fine and the seed so small that very little trauma is done to the tonsil.

The amount of radiation can be measured with accuracy and the applicators located with such exactness as to insure equal and complete distribution throughout the tissues. Only one treatment is necessary, a fact much appreciated by the patient. Systemic reactions of any kind have not occurred by the use of this method. The attached thread, making the seed easily removable when its period of service is over, does away with an objectionable foreign body being left in the tissues—a drawback to the bare tube method. The author concludes that in the implantation of removable platinum radon seeds we have at present an adequate substitute for tonsillectomy in those cases where surgery is, for any reason, contra-indicated.

The technic and method described in the article have been developed by Joseph Muir, of New York.

*Irradiation of Diseased Tonsils. J. Coleman*  
*Scal. Med. Jour. and Rec., Dec. 1, 1926,*  
*CXXIV, 673.*

**Irritation tumors.**—This is a very good review of our present knowledge regarding tumors appearing after irradiation, those due to parasites, to mechanical chronic inflammations, to physical and chemical agents. It furnishes a bibliography of 254 references and is warmly recommended for study in the original text.

E. A. POHLE, M.D.

*Clinical and Experimental Results of Investigations Dealing with Irritation Tumors.*  
*K. Brandes. Strahlentherapie, 1926, XXIII,*  
*715.*

**Results of exposure of thorax to radiation.**

—The term "pulmonary fibrosis" is cited as a misnomer, since the alterations in the tissues have not been reported in any case to be sufficient to lead to permanent fibrotic changes. That roentgen rays are more commonly re-

sponsible for the phenomenon is due to the fact that they are employed more often than radium in the treatment of diseases of or new-growths in the thorax; if radium were employed over equally extensive thoracic surfaces, even more marked changes might result.

The onset of pleuropneumonitis follows the application of the radiation by some two to four weeks, and in the cases where it is sudden gives the patient the impression that she has taken a cold. The symptoms consist of cough, dyspnea, occasionally pain in the chest (not severe or prolonged), and some cases of fever have been observed. Hemoptysis is quite rare, as is also a burning sensation in the chest. The acute stage passes in from one to three weeks, but the cough and shortness of breath have been known to persist for a period of several weeks or even months. During this acute stage a definite increase in the pulse rate is common, its sudden onset being observed by the patient. If she is not submitted to further roentgen treatment over the thoracic area, the symptoms gradually diminish in severity, and ultimately disappear, "as the remaining lung tissue adapts itself to its new functional requirements, and as more or less of the injured pulmonary parenchyma recovers its normal activity."

The paper goes on to state in detail the physical and roentgenologic signs which mark the condition, and the manifestations which must be evaluated in making a differential diagnosis from pulmonary metastasis or abscess. Periodic roentgenographic examinations enable one to feel reasonably certain of one's ground. In the author's own phrases: "This is all the more important when the roentgenologist makes his interpretations without any knowledge of the clinical aspects of the case. I make it a point to mention this, because a hasty roentgenologic diagnosis may work an injustice to the patient. Inasmuch as the present-day clinician depends to a considerable extent on the roentgen-ray findings in estimating the condition of the patient's intrathoracic structures, it is of the utmost importance that he receive no impression that does not rest on solid ground."

The author dismisses the claim that has been made by nearly all writers on the subject that

this inflammatory condition affecting pleura and lungs is related in any way to the use of roentgen rays of short wave length, and states that the wave length of the rays plays but a comparatively small part in the problem. The chief factor, he says, is quantitative, and relates to the dose as it is affected by the length of the exposure, or, in other words, that inflammatory reactions in the pleura and lungs "are the more likely to supervene the nearer the dosage approaches, or passes beyond, the limit of normal skin tolerance." If the dose given is such as to produce a marked skin reaction, the pulmonary structures are likely to be irritated in consequence. The author goes fully into a discussion of why this should be so, basing his observations upon cases analyzed by himself.

M. INGLEHART.

*The Reaction of the Pleura and Lungs to Roentgen Rays. Arthur U. Desjardins. Am. Jour. Roentgenol. and Rad. Ther., November, 1926, p. 444.*

**Cancer of cervix.**—The author states that at the Zurich University clinic X-ray treatment is given in every case of carcinoma of the cervix uteri as soon as the clinical diagnosis has been confirmed by biopsy. From three to six weeks later the abdomen is opened and the operability of the case is estimated with the pelvic tissues exposed to view and to internal palpation. Whenever it is possible Wertheim's operation is done; in inoperable cases after-treatment is given first by radium and then by X-rays. Subsequent treatment in cases in which it has been possible to do extended (Wertheim) hysterectomy is guided by histological criteria. The margins of the excised tissue are microscopically examined; if it is found that excision has been made through malignant tissue, X-ray treatment is begun at once, a small series of applications separated by considerable intervals being preferred. If, on the other hand, the ablation appears to have been made through healthy tissue, X-ray treatment is given only if a recurrence of the growth becomes manifest later. Fürst believes that X-ray and radium treat-

ments, although indispensable accessories, do not possess so great a value in treatment of cancer of the cervix as was formerly hoped. He has found by inquiry that of thirty-six Swiss and German university clinics, only six adopt radiotherapy exclusively. Among the advantages claimed for preliminary treatment of all cases of carcinoma of the cervix by X-rays are that in cases afterward operated on, suppuration and inflammation around the tumor are diminished, and that in inoperable cases the shrinkage of the tumor after X-ray application enhances the effect of radium therapy.

F. Heimann (*ibid.*, p. 1945), on the other hand, while conceding that the disappearance of suppuration and the epithelialization of the portio cervicis which follow X-ray treatment of cervical carcinoma may be of great benefit, asserts that streptococci, if locally present before this treatment, are invariably to be found afterwards. An equally efficient diminution of local sepsis may be secured, he finds, by cautery excision and application of 5 per cent alcoholic solutions of thymol. In this way can be avoided the delay of several weeks before operation, during which the neoplastic permeation may extend.

*The Question of Irradiation and of Carcinoma of the Uterine Cervix. W. Fürst. Zentralbl. f. Gynak., July 24, 1926, p. 1938. (Reprinted by permission from Brit. Med. Jour., Oct. 30, 1926, p. 67 of Epitome of Current Medical Literature.)*

**X-ray examination of uterus.**—The author records his experience of the injection, for diagnostic purposes, of 40 per cent iodine solution in vegetable oil (iodipin) into the uterus, with subsequent X-ray examination. In 38 cases he has seen no untoward results follow. The amount injected, slowly and gently, was 7 c.cm.; screening was performed at once, and the patient returned home. The oil disappears from the abdomen more quickly than from the spinal canal, and has been found to be absent fourteen days after uterine injection, although in one patient it was still



present in small amounts in the pelvis sixty days later. Newell finds this procedure particularly valuable (1) in sterility cases with tubal obstruction, to localize the obstruction and determine whether an operation is likely to be useful; (2) when several masses are palpable within the pelvis, so that the uterus can be distinguished from the others; (3) when the pelvis is blocked by one large mass, and it is doubtful whether this originates from ovary or uterus; (4) when intra-uterine or extra-uterine foreign bodies are suspected; (5) as an indication of the size of the uterus and a possible encroachment on its cavity by tumor. The iodine injections may also help in the differential diagnosis of chronic appendicitis from right-sided salpingitis, and of tuberculous from infective salpingitis. Of Newell's patients 30 came later to laparotomy.

*Use of Iodized Oil (Iodipin) as a Diagnostic Aid in Gynecology. Quitman U. Newell. Am. Jour. Obst. and Gynec., August, 1926, p. 189. (Reprinted by permission from Brit. Med. Jour., Oct. 30, 1926, p. 67 of Epitome of Current Medical Literature.)*

**Gaseous cysts of the bowels.**—It is very often surprising to find at the autopsy table gaseous cysts of the bowels, unexpected both by the clinician and the pathologist. The final obductional diagnosis must be regarded as depending altogether upon a casual event. The same happens on the operating table. The authors have observed a complexity of symptoms, coupled with roentgenologic findings, which, at operation and autopsy as well, have proved to be diagnostic of the disease. The most striking symptom is ptosis of the liver, while the region between it and the vault of the right diaphragm seems to contain air. Other roentgenologic findings are: cauda of the liver is not only low down below the crest of the ilium, but in the erect posture is usually found more medially situated. There is also a stenosis of the pylorus, with consequent dilatation of the stomach. It is to be borne in mind, however, that the air below the right diaphragm disappears after the patient assumes a prone position.

Close attention should be paid to the possible synchronous existence of an ectopia of the larger intestines. An abnormal position of the latter is very likely to mislead one into an erroneous diagnosis, and the examiner, before coming to the conclusion of a gaseous cyst, must first exclude the anomaly. But there are still other signs upon the radiographic plate which should be considered in order to permit one to arrive at a true differentiation. The signs are those of a subphrenic abscess and, in rarer cases, of some intestinal coils containing gas.

I. JOSEFSBERG, M.D.

*Radiologic Diagnosis of Gas Cysts of the Intestines. Bonnamour, Badolle and Beaupere. Jour. de Radiol. et d'Electrol., April, 1926, p. 164.*

#### **Radiotherapy for menstrual disorders.**—

The author discusses the treatment of menstrual disorders in the light of recent physiological research. He thinks that since the amenorrhea associated with increasing obesity is undoubtedly of endocrine causation, organotherapy appears to be the most logical and least harmful form of treatment, and, though at present frequently unsatisfactory in its results, Novak considers that the further development of biochemical methods will eventually lead to improvement in this direction. In the treatment of dysmenorrhea atropine, given to the point of saturation and commencing several days before the period is expected, often relieves when analgesic drugs fail. In some cases where this is not effective the presence of a definite causative anatomic lesion, such as a small interstitial or submucous myoma, must be suspected. Pituitary, ovarian, or thyroid extracts are disappointing. Dilatation of the cervix often gives good results, while stem pessaries are to be condemned. The functional uterine hemorrhage of puberty, when mild, tends to spontaneous cure, but when severe, diagnostic curettage is indicated and in most cases results in permanent cure. Novak has seen good results following the daily use of pituitary extract.

In persistent functional bleeding near the menopause complete cessation follows radio-



therapy, and though this treatment, if cautiously used, may be advocated in younger patients, the danger of producing permanent amenorrhea and sterility must be explained to the patient. Many gynecologists prefer to rely upon a repetition of the curettage rather than to have recourse to radium in the case of young women.

*The Treatment of Menstrual Disorders.* Emil Novak. *Therapeutic Gazette*, May 15, 1926, p. 315. (Reprinted by permission from *Brit. Med. Jour.*, Oct. 9, 1926, p. 56 of *Epitome of Current Medical Literature*.)

**Action of radium on bone.**—The effect of bacterial infection upon bone is well known, but the destructive process through which bone passes when its blood supply is interrupted or it is acted upon by chemicals is not so clearly understood. The author performed four experiments on dogs, inserting a 12.5 mg. needle of radium into the knee, in contact with the lateral surface of the mesial condyle of the femur. The needle was left in position for eighteen hours, immobilization being effected by a cast. Eighty-eight, 97, 252 and 400 days, respectively, after the use of the radium, the dogs were killed and the irradiated areas examined. The results, described in detail, are summed up in the following conclusions: "(1) Uninfected necrotic bone produced by the implantation of radium is disposed of differently according to whether or not it functions mechanically in the support of the part. (2) If an entire segment of the

femur or humerus of a dog is killed and subsequently used in weight-bearing, the dead bone will not be sequestered, but will slowly undergo creeping substitution by ingrowing new bone. (3) If it is not used, as a result of non-union of a fracture through it, the necrotic bone will be sequestered from the living bone and very slowly absorbed. (4) Because of the radium burn of the adjacent bone and soft parts, the rate of creeping substitution by new bone or of absorption is much slower than in the case of aseptic necrotic bone, the result of circulatory disturbance or of the application of chemicals. (5) Secondly infected areas of bone killed by radium undergo sequestration, whether or not they function mechanically during the period of sequestration."

Three cases of sarcoma are reported, in which radium needles were left in contact with bone in an aseptic field for periods sufficiently long to produce necrosis, and the results observed by periodic roentgen examination. These findings are summed up in the following conclusions: "(6) Bone killed by radium in the treatment of tumors is gradually replaced by new bone if it remains free from infection and functions in the support of the part. (7) When a small necrotic portion borders on an articular surface, it does not become detached and go free into the joint as a joint mouse."

M. INGLEHART.

*Radium Necrosis of Bone.* D. B. Phemister. *Am. Jour. Roentgenol. and Rad. Ther.*, October, 1926, p. 340.

#### ANNOUNCEMENT

The American Association of Radiological Technicians will hold their annual meeting in Chicago, April 25, 26 and 27, 1927. Headquarters will be at the La Salle Hotel. A program of clinics and lectures is being arranged.

Further particulars may be obtained from Miss Margaret Hoing, Chairman of the Executive Committee, 2551 North Clark Street, Chicago, or Miss Jean McCulloch, Chairman of the Program Committee, 283 North Avon, Saint Paul, Minn.

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